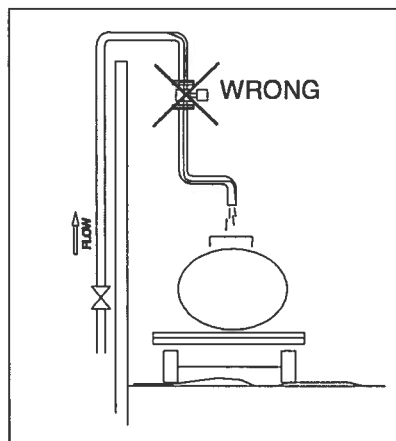


## Model M-2000 Mag Meter

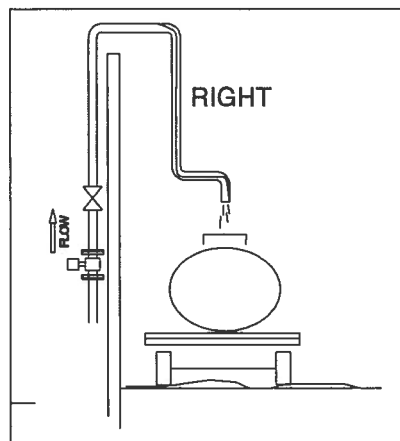
---

Do not install the meter in a vertical, downward flow section of pipe.

Always position the ON/OFF valves on the downstream side of the meter.

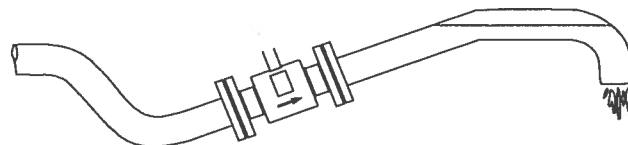
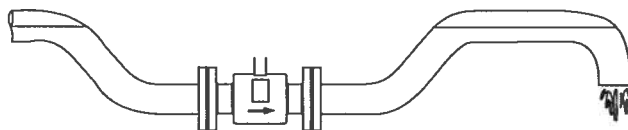


Do not install in a vertical, downward position.



Position "On/Off" valves on downstream side.

To minimize the possibility of partially-full pipe flows in horizontal, gravity or low pressure applications, create a pipe arrangement that ensures the detector remains full of liquid at all times.

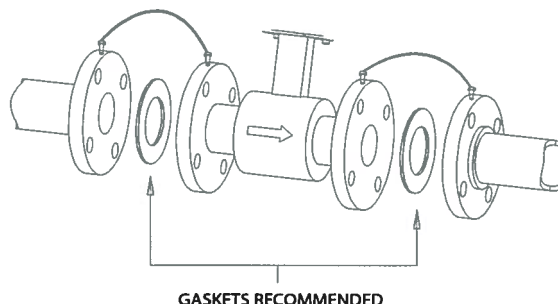


## Meter Gaskets and Grounding

Gasket and grounding requirements must be considered when determining the meter location, orientation and application.

### Meter/Pipeline Connection Gaskets

You must install gaskets (not provided) between the detector's isolating liner and the pipeline flange to ensure a proper and secure hydraulic seal. Use gaskets that are compatible with the fluid. Center each gasket on the flange to avoid flow restrictions or turbulence in the line.



During installation, do not use graphite or any electrically conductive sealing compound to hold the gaskets. This could compromise the accuracy of the measuring signal.

If you are using a grounding ring in the detector/pipeline connection, place the ring between two gaskets. (See *Non-Conductive Pipe Grounding* section, page 14.)

### Meter Grounding

Process pipeline material can be either electrically conductive (metal) or not electrically conductive (made of or lined with PVC, fiberglass or concrete).

#### IMPORTANT

It is essential that the mag meter amplifier's input ground (zero voltage reference) be electrically connected to the liquid media and to a good, solid earth ground reference.

### Conductive Pipe Grounding

To achieve an adequate ground, the meter body **MUST** be electrically connected to the liquid media. The mag meter flanges are provided with grounding bolts for this purpose.

If the pipe material is electrically conductive, simply install grounding straps between these grounding bolts and the mating flanges.

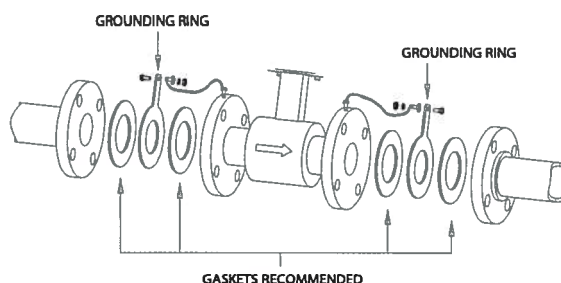
To ensure a good electrical connection at the mating flanges, we recommend that you drill and tap the flanges and install a grounding screw (not provided).

These grounding straps must be copper wire, at least 12AWG size. They must be connected on both sides (inlet and outlet) of the detector and to a local, earth ground.

### Non-Conductive Pipe Grounding

#### IMPORTANT

If the process pipe is not electrically conductive (PVC, fiberglass, cement-lined pipes or any other non-conductive material) and the meter was not originally ordered with an optional grounding electrode, you must install a pair of grounding rings between the mating flanges at both ends of the meter. See the following illustration.



In this case, the grounding straps should be connected to both of the grounding rings and to a good, solid earth ground. Grounding rings are available in stainless steel. If your fluid is too aggressive for stainless steel, order a meter with the optional grounding electrode in a material compatible with the fluid.

### Amplifier Mounting Configuration Options

There are two configuration options for mounting the amplifier. There are many options to accommodate a variety of meter-placement and environmental conditions.

#### Meter Mount Configuration

The meter mount configuration has the amplifier mounted directly on the detector. This compact, self-contained configuration minimizes installation wiring.

#### Remote Mount Configuration

The remote mount configuration places the amplifier at a location away from the fluid flow and detector. This is necessary in situations where process fluid temperature or the environment exceeds amplifier ratings.

The detector and amplifier are connected by wires, run through conduit, between junction boxes on the detector and the amplifier. The distance between the detector junction box and amplifier junction box can be up to 500 feet (152 meters). A remote mounting bracket is supplied.

#### Submersible Option

If you are installing the meter in a vault, you should order the remote amplifier option. You must not install the amplifier inside a vault. We also recommend ordering the remote meter package with the submersible option (NEMA 6P). This will eliminate any potential problems resulting from humidity or temporary flooding in the vault.

**Note: The National Electronics Manufacturer's Association (NEMA) 6P enclosures are constructed for indoor or outdoor use to provide protection against access to hazardous parts; to provide a degree of protection against ingress of solid foreign objects and water (hose directed water and the entry of water during prolonged submersion at a limited depth); that provide an additional level of protection against corrosion and that will be undamaged by the external formation of ice on the enclosure.**

## Wiring

### Wiring Safety

#### **⚠WARNING**

At installation, be sure to comply with the following requirements:

- Disconnect power to the unit before attempting any connection or service to the unit.
- Do not bundle or route signal lines with power lines.
- Keep all lines as short as possible.
- Use twisted pair shielded wire for all output wiring.
- Observe all applicable, local electrical codes.

### Opening the M-2000 Cover

The M-2000 amplifier's design lets you open the cover without completely removing it.

#### **⚠WARNING**

Cover is attached with display ribbon cable.

To open the cover you will need a blade screwdriver.

Follow these steps:

1. Disconnect power to the unit.
2. Completely remove the two screws from either the left or the right side of the amplifier.
3. Loosen each of the remaining screws so that the round head of the screw clears the top edge of the cover.



4. Lift and pivot the cover into the open position.



### Power Connections

#### External Disconnect

##### **⚠ CAUTION**

Install an external disconnect switch or circuit breaker that meets local standards.

Position the M-2000 in an accessible location.

Position and identify the disconnect device so as to provide safe and easy operation.

Label the disconnect device as being for the mag meter.

#### AC Power Wiring

For the AC power connections, use three wire-sheathed cable with an overall cable diameter of 0.2 inch to 0.45 inch (5 mm to 12 mm). For signal output, use 18 to 22 gauge (0.25 mm<sup>2</sup> to 0.75mm<sup>2</sup>) shielded wire. Overall cable diameter between 0.12 inch and 0.35 inch (3 mm to 9 mm).

##### **⚠ CAUTION**

To prevent accidents, connect main power only after all other wiring has been completed.

The amplifier is a microprocessor device. It is important that the power supply be as "clean" as possible. Avoid using power lines that feed heavy loads: pumps, motors, *etc.* If dedicated lines are not available, a filtering or isolation system may be required.

Power wiring is the same for meter mount and remote mount amplifiers.

#### Remote Mount Installation

If you are installing the M-2000 amplifier in a remote location, review the procedures in this section.

#### Mount Bracket to Amplifier

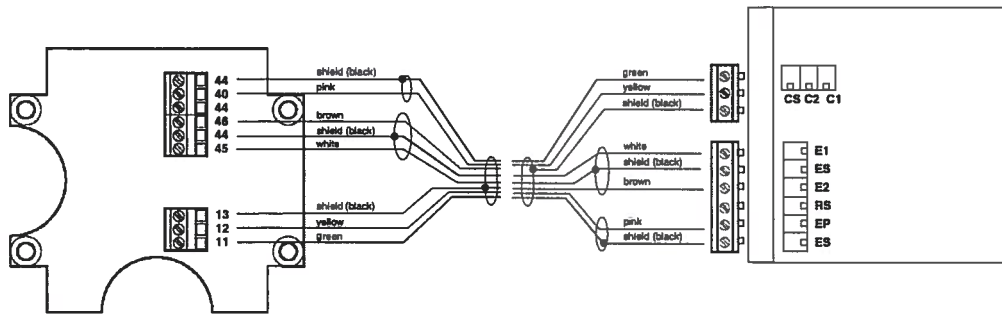
1. Align bracket-mounting holes with amplifier mounting holes.
2. Attach bracket to amplifier with supplied screws. Torque screws to 80 inch pounds.

#### Wiring Configuration

Wiring between the detector and the M-2000 amplifier comes complete from the factory. If your installation requires the use of conduit, we recommend that you follow these steps when wiring the detector to the amplifier.

1. Remove the junction box lid. Carefully remove the wires connected to the terminal blocks that run to the M-2000 amplifier. See the chart below for a reference of wire color to terminal connection.
2. Run cable through the conduit from the amplifier location while retaining the wiring of the cable to the amplifier, as supplied.
3. Complete conduit assembly on both ends and rewire the cable into the junction box as it was previously wired.

## Wiring for Remote Configuration



Remote style M-2000 amplifier models can be ordered with standard cables measuring 15, 30, 50 and 100 feet. In addition, cables up to 500 feet are available.

| Junction Box   |                   |                    | Amplifier  |
|----------------|-------------------|--------------------|------------|
| Connection No. | Description       | Wire Color         | Connection |
| 11             | Coil              | Green              | C1         |
| 12             | Coil              | Yellow             | C2         |
| 13             | Main Shield       | Black (Red Ferrul) | CS         |
| 45             | Electrode         | White              | E1         |
| 44*            | Electrode Shield  | Black              | ES         |
| 46             | Electrode         | Brown              | E2         |
| 40             | Empty Pipe        | Pink               | EP         |
| 44*            | Empty Pipe Shield | Black              | ES         |

\*Connections with the No. 44 are lying on the same potential.

## Empty Pipe Detection Considerations

Take into account the following cable length and conductivity requirements, if you will be using empty pipe detection.

| Cable Length (Feet) | Minimum Conductivity Required ( $\mu S/cm$ ) |
|---------------------|--|
| 0*                  | 5  |
| 100                 | 20   |
| 500                 | 100  |

\* Meter Mount

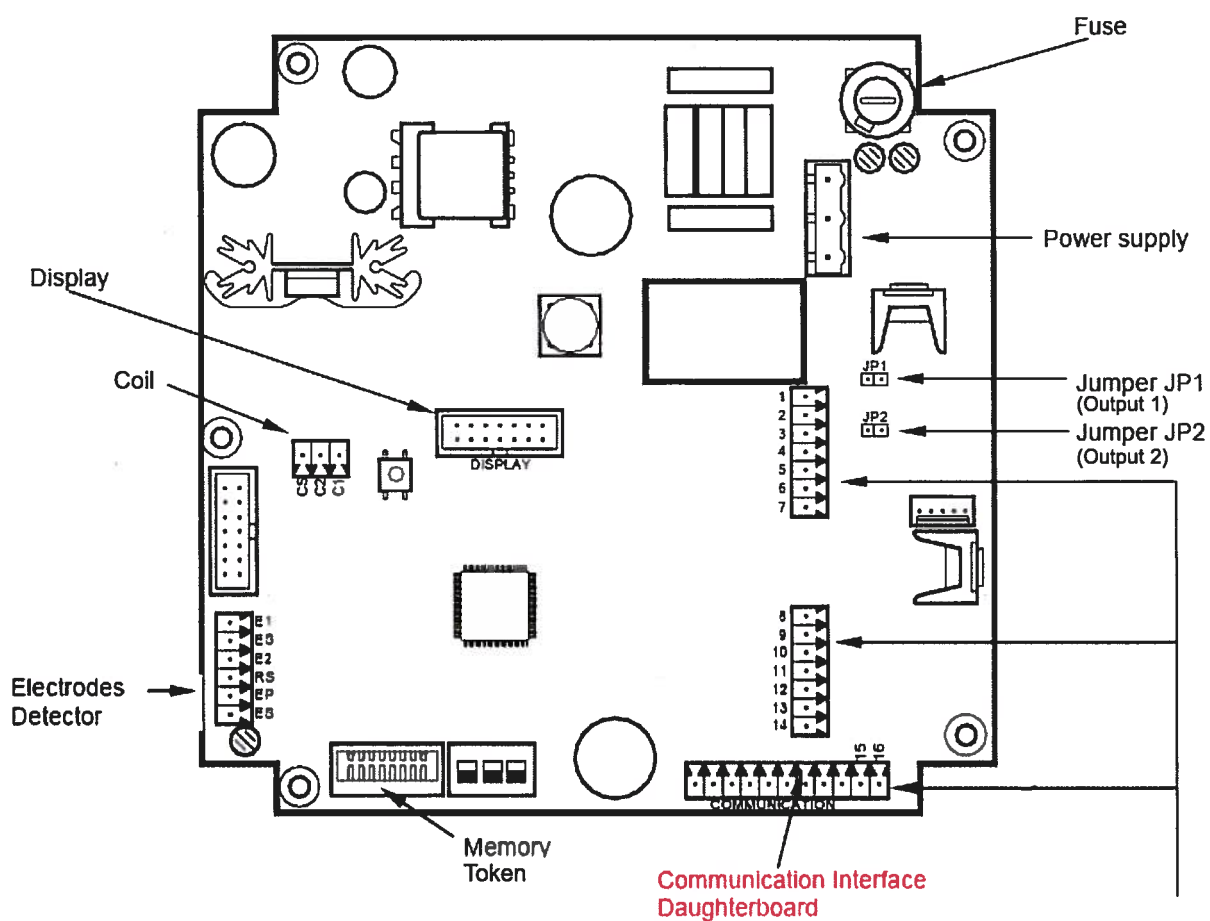
## Configuring Input/Output (I/O)

This section describes wiring the following M-2000 inputs/outputs:

- Analog output
- Digital input
- Digital outputs
- Communication

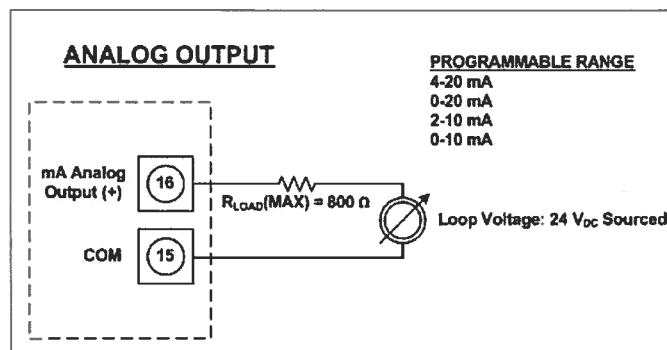
Once the sensor and the amplifier have been wired, wire any inputs and outputs to the M-2000 amplifier.

Do not connect the main power connection until you have made all other wiring connections. Follow all of the safety precautions and local code to prevent electrical shock and damage to the electronic components.

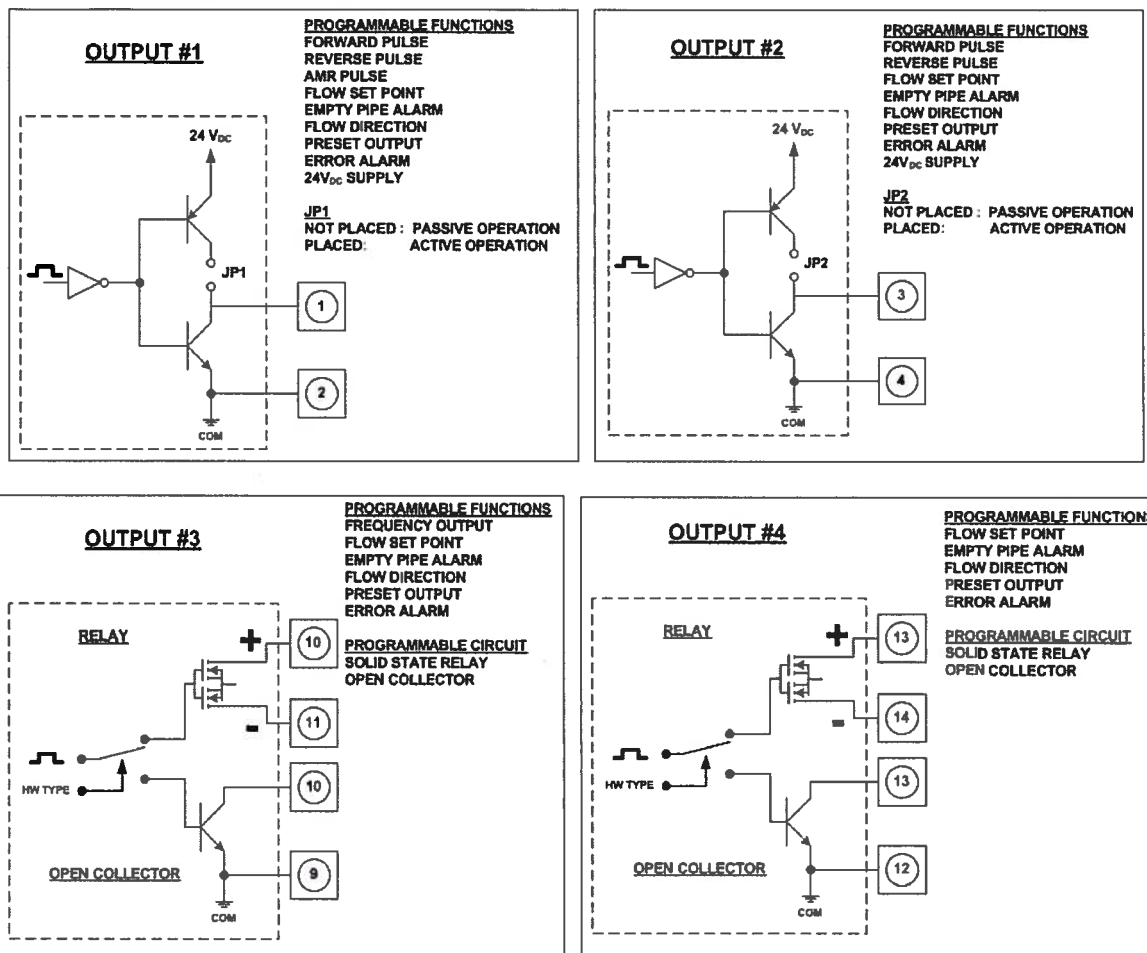


| Input/Output               | Description  | Terminal                               |
|----------------------------|--|--|
| Analog Output              | 0-20 mA    Resistive Load < 800 ohms<br>4-20 mA    Resistive Load < 800 ohms<br>0-10 mA    Resistive Load < 800 ohms<br>2-20 mA    Resistive Load < 800 ohms | 16 (+)<br>15 (-)                       |
| Digital Output 1           | Passive max. 30 VDC, 100 mA<br>Active 24 VDC, 50 mA (set Jumper JP1)<br>Max. Frequency 10 kHz  | 1 (+) and 2 (-)                        |
| Digital Output 2           | Passive max. 30 VDC, 100 mA<br>Active 24 VDC, 50 mA (set Jumper JP2)<br>Max. Frequency 10 kHz  | 3 (+) and 4 (-)                        |
| Digital Output 3           | Passive Max 30 VDC, 100 mA, 10 kHz<br>Solid State Relay 48 VAC, 500 mA, 1 kHz<br>* Software configurable   | 10 (+) and 9 (-)<br>10 (+) and 11 (-)  |
| Digital Output 4           | Passive Max 30 VDC, 100 mA, 10 kHz<br>Solid State Relay 48 VAC, 500 mA, 1 kHz<br>* Software configurable   | 13 (+) and 12 (-)<br>13 (+) and 14 (-) |
| Digital Input              | 5 - 30 VDC   | 8 (+) and 9 (-)                        |
| Communications<br>(Port A) | RS232, configurable, Modbus RTU or RDI.  | 7 GND<br>6 Rx<br>5 Tx                  |

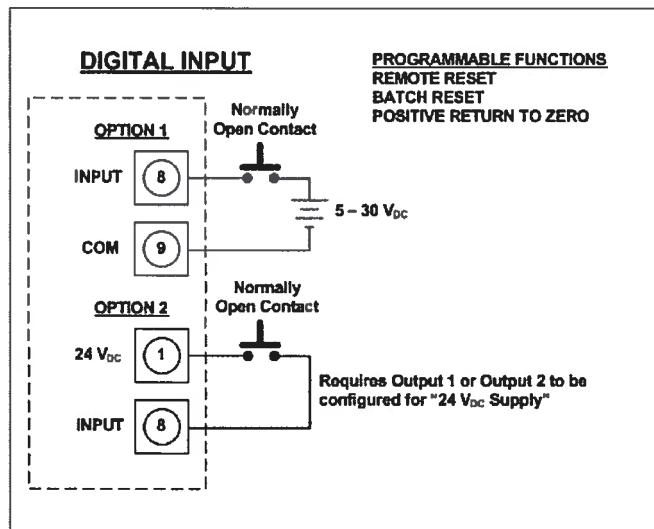
#### Analog Output Wiring Diagram



## Digital Output Wiring Diagrams



## Digital Input Wiring Diagram



## Programming the M-2000

The M-2000 amplifier comes preprogrammed from the factory. Typically, you will not need to do any additional programming. However, to take advantage of special features, you can program the meter for your specific needs. If you will be programming the meter, familiarize yourself with the M-2000 Function Buttons and follow the procedures outlined below.

### Displays

There are two types of displays on the M-2000:

- Menu Selection
- Numeric Entry

#### Menu Selection Display

Menu selection displays will appear in the following format:

```
DISPLAY TITLE
>Menu Selection 1
  Menu Selection 2
DIRECTIONS LINE
```

Display format

```
START MENU
>Exit this Menu
  Main Menu
MORE: ↑,↓      ENTER:>
```

Example menu

The top line shows the title of the display screen. Below that are two visible menu selections. The bottom line provides directions for user input.

Typically, a menu contains more options than will fit in the two, menu selection lines. Press the [↑] and [↓] buttons to scroll the display text up and down one line at a time. When the arrow is pointed to your desired menu option, press [E] to select the item and open its display.

#### Numeric Entry Display

Numeric entry displays will appear in the following format:

```
DISPLAY TITLE
  Description Line
    Numeric Value
DIRECTIONS LINE
```

Display format

```
LOW FLOW CUTOFF
% of      300.000 GPM
      2.00%
CHG: +, -    NEXT:E
```

Example numeric entry display

The top line shows the title of the display screen. The second line is a description of the value. The third line shows the current value. The bottom line provides directions for user input.

**Note:** The bottom line of a numeric-value display provides prompts regarding the function of each button. The [↑] or [↓] button will change the value of the numeral. The [E] button will move the cursor one digit to the right. When the cursor is at the final, right-most digit, pressing [E] will reposition the cursor at the left-most digit. The bottom line display will change to reflect the new function of the [E] button. Press [E] to save the current entry. Press [↑] to edit the current entry.

```

LOW FLOW CUTOFF
% of      300.000 GPM
          3.00%
EDIT: +      SAVE: E
    
```

Details on how to change and set numeric values are described in the following section, **Function Buttons**.

## Function Buttons

All M-2000 programming is accomplished using the three function buttons located on the front of the amplifier:



**Note:** Throughout this manual, the buttons will be referred to as: [↑] or [↑] and [↓] or [↓], depending on the context. The "Enter" button will be referred to as [E].



Consider the [↑] button as the "next step" or "scroll text up" button. During programming, pressing this button will go to the next menu selection, or increment a numeral.

**Example 1:** The illustration below shows the M-2000 Main Menu. The selection arrow is pointing to the Exit this Menu selection.

To scroll up to the menu's next selection, press [↑] once. The menu text scrolls up to the next menu selection, Main Menu.

```

START MENU
>Exit this Menu
  Main Menu
MORE: ↑,↓      ENTER:>
    
```

Press  
[↑]

```

START MENU
> Main Menu
  Quick Setup
MORE: ↑,↓      ENTER:>
    
```

**Example 2:** Some procedures require you to enter a numeric value. The [↑] button is used to increment the selected numeral. The illustration below, shows the Low Flow Cutoff parameter display. Notice the cursor under the 2 in the ones' place. In this case, press [↑] once to increment the numeral to the value of 3.00%.

```

LOW FLOW CUTOFF
% of      300.000 GPM
          2.00%
CHG: +, -      NEXT: E
    
```

Press [↑]

```

LOW FLOW CUTOFF
% of      300.000 GPM
          3.00%
CHG: +, -      NEXT: E
    
```



Consider the Down Arrow [ - | ↓ ] button as the "previous step" button. During a procedure, pressing this button will go to the menu's previous selection or decrement a numeral.

**Example 1:** The illustration below shows the M-2000 Main Menu. The selection arrow is pointing to the Meter Setup selection. To scroll the text down to the menu's previous selection, Exit this Menu (which is not visible on the display), press [↓] once.



**Example 2:** For procedures that require you to enter a numeric value, the [-] button is used to decrement the selected numeral. The illustration below shows the Low Flow Cutoff parameter display. Notice the cursor under the 3 in the ones' place. In this case, press the [-] once to decrement the numeral to the value of 2.00 %.



The [E] button functions as an "Enter" button, or "cursor right" button.

**Example 1:** The illustration below shows the M-2000 Main Menu. The selection arrow is pointing to the Meter Setup selection. Press [E] to select Meter Setup, and open the Meter Setup display.



In cases where you are entering a numeric value, the [E] button does not function as the "Enter" button, but rather, will move the cursor to the right. When the cursor is at the right-most position, the [E] will now serve as the Enter key.

**Example 2:** The illustration below shows the Low Flow Cutoff display. The cursor is under the 3 in the ones' place. In this case, press [E] to move the cursor to the right one digit.



### Security

The M-2000 security feature gives you the option to restrict access to the meter by way of a five-digit Personal Identification Number (PIN). The system administrator can set up a single PIN for each of the three different levels of access:

- **Administration** - allows access to all M-2000 menu configuration screens.
- **Service** - allows access to service-level and user-level menu configuration screens.
- **User** - allows access only to user-level menu configuration screens.

Not all levels of access need to be set. If no PINs are set up, any M-2000 user will have access to all functions.

**Note: The security settings will also apply to remote access. All remote writes to the meter will be blocked unless the user is remotely logged in.**

### Setting the Administration PIN

Users logged in with the Administration PIN have access to all M-2000 menu configuration screens.

To set the administrator's PIN, follow these steps from the **Advanced Menu**:

1. Select **Security** to view the Security menu.
2. Select **Set Admin PIN** to view the Admin PIN display.
3. Set the five-digit PIN number to the desired value.
4. Press [E] to save the PIN and to return to the Security menu.

### Setting the Service PIN

Users logged in with the Service PIN have access to service level menu configuration screens. Service users will not have access to administrative screens.

**Note: In order to set a service-level PIN, you must first set up an administration PIN.**

To set the service PIN, follow these steps from the **Advanced Menu**:

1. Select **Security** to view the Security menu.
2. Select **Set Service PIN** to view the Service PIN display.
3. Set the five-digit PIN number to the desired value.
4. Press [E] to save the PIN and to return to the Security menu.

### Setting the User PIN

Users logged in with this User PIN have access to user-level procedures. Users will not have access to administrative or service screens.

**Note: In order to set a user-level PIN, you must first set up an administration PIN and a service PIN.**

To set the user's PIN, follow these steps from the **Advanced Menu**:

1. Select **Security** to view the Security menu.
2. Select **Set User PIN** to view the User PIN display.
3. Set the five-digit PIN number to the desired value.
4. Press [E] to save the PIN and to return to the Security menu.

## Entering Your Personal Identification Number (PIN)

If your system has been set up with PIN security, you will need to enter a PIN to access programming functions. There are three possible access levels, each with its own unique PIN: User, Service and Administration. Your system administrator will provide you with the appropriate PIN.

**Note: All PINs are factory set to 00000. At this setting, you will not be required to enter a PIN. If the system administrator has not set the PIN, pressing [E] from the Start Screen opens the Main Menu.**

**If you forget or misplace your PIN, call Badger Meter Customer Service to get a master password. When you call, have the security code that appears in the upper right corner of the PIN Request display.**

Follow these steps to enter your PIN in the M-2000:

1. At the **Main Menu**, press [E]. The **PIN Request** display opens.

PIN REQUEST 12345  
Please enter  
pin #: 00000  
CHG: +, - NEXT: E

Security Code

2. Press [+] to increment the numeral.
3. Press [E] to move the cursor to the next digit.
4. Repeat the steps to set each of the five digits to match your PIN.
5. Press [E]. If you entered a valid PIN, the **Main Menu** opens indicating your level of access.

If you entered the wrong PIN, you will see the following display:

MENU ACCESS  
DENIED

- Press [E] to return to the **PIN Request** display.
- Repeat Steps 1 through 5.

**Note: Be sure to log off when you have completed work with the M-2000. Otherwise, there will be a five-minute delay between your last activity and the time when the M-2000 will automatically log you off.**

## Setting Up the M-2000 with Quick Setup

The M-2000 provides you with a Quick Setup utility that allows you to set or change your Flow Units, Totalizer Units, Full Scale Flow and Low Flow Cutoff settings. To open the Quick Setup, select Quick Setup from the Start menu.

Quick Setup

Flow Unit

[GPM]

Flow Unit lets you set the unit of measure for the flow rate and full scale flow.

To change the Flow Unit value, follow these steps from the **Quick Setup** menu.

1. Select **Flow Unit** to view the Flow Unit display.

2. Press [↑] or [↓] to position the arrow next to one of the following Flow Units:

| Code | Flow Unit        | Code | Flow Unit      |
|------|------------------|------|----------------|
| LPS  | Liter/Second     | GPM  | Gallons/Min.   |
| LPM  | Liter/Minute     | GPH  | Gallons/Hour   |
| LPH  | Liter/Hour       | MGD  | MegaGallon/Day |
| M3S  | Cubic Meter/Sec. | IGS  | UKG/Sec.       |
| M3M  | Cubic Meter/Min. | IGM  | UKG/Min.       |
| M3H  | Cubic Meter/Hour | IGH  | UKG/Hour       |
| F3S  | Cubic Feet/Sec.  | LbM  | Pound/Min.     |
| F3M  | Cubic Feet/Min.  | OPM  | Ounce/Min      |
| F3H  | Cubic Feet/Hour  | BPM  | Barrel/Min     |
| GPS  | Gallons/Sec.     | --   | --             |

3. Press [E] to save the Flow Units setting.

Totalizer Unit

[USG]

This parameter establishes the units of measure for the totalizers.

To change the Totalizer Unit value, follow these steps from the **Totalizer Unit** display.

1. Press [↑] or [↓] to position the arrow next to one of the following Totalizer Units:

| Code | Totalizer Unit | Code | Totalizer Unit   |
|------|----------------|------|------------------|
| L    | Liters         | UKG  | Imperial Gallons |
| HL   | HectoLiters    | Lb   | Pounds           |
| M^3  | Cubic Meters   | Oz   | Fluid Ounces     |
| CFt  | Cubic Feet     | Aft  | Acre Feet        |
| USG  | U.S. Gallons   | BBL  | Barrel           |
| MG   | MegaGallons    |      |                  |

2. Press [E] to save the Totalizer Units setting.

## Quick Setup

|                        |   |
|------------------------|---|
| <b>Full Scale Flow</b> | <p>This parameter sets the maximum flow the system is expected to measure. This parameter has influence on other system parameters. These parameters include:</p> <ul style="list-style-type: none"> <li>• Frequency Output – Full scale frequency is observed at full scale flow</li> <li>• Low Flow Cutoff – Changes to full scale flow affect the measuring cut-off threshold of the meter</li> <li>• Alarm Outputs – Changes to full scale flow adjusts the thresholds for generating set point alarms</li> <li>• Pulse Outputs – Changes to full scale flow adjusts the pulse frequency and duty cycle</li> <li>• Analog Outputs – Changes to full scale flow adjusts the interpretation of the analog output signal</li> </ul> <p>Change the full scale flow based on the meter size and the application's requirements. Verify that the full scale flow falls within the meter's suggested flow range limits. In terms of flow velocity, the meter's limits are from 0.1 to 39.4 feet/second.</p> <p>The full scale flow is valid for both flow directions.</p> <p><b>Note: If the flow rate exceeds the full scale setting, an error message indicates that the configured full scale range has been exceeded. However, the meter will continue to measure. This will affect the latency of the pulse outputs and possibly cause overflow. Furthermore, the analog output may also be placed in alarm mode.</b></p> <p>To set or change the Full Scale Flow, follow these steps from the <b>Quick Setup</b> menu:</p> <ol style="list-style-type: none"> <li>1. Select <b>Full Scale Flow</b> to view the Full Scale Flow display.</li> <li>2. Set the full scale flow value to the desired setting.</li> <li>3. Press <b>[E]</b> to save the full scale flow value and return to the Measurements menu.</li> </ol> |
| <b>Low Flow Cutoff</b> | <p>Low flow cutoff defines the threshold at which flow measurement will be forced to zero. The cutoff value can be set from 0% to 10% of the full scale flow. Increasing this threshold will help prevent false readings during "no flow" conditions possibly caused by pipe vibration or inherent system noise.</p> <p>To change Low Flow Cutoff, follow these steps from the <b>Low Flow Cutoff</b> display.</p> <ol style="list-style-type: none"> <li>1. Set the Low Flow Cutoff value to the desired setting, between 0% and 10%.</li> <li>2. Press <b>[E]</b> to save the value.</li> </ol>   |

## Using the M-2000's Main Menu Programming Options

The following M-2000 programming options are available from the Main Menu:

- Meter Setup
- Measurements
- Inputs/Outputs
- Clear Totals
- Communications
- Advanced
- Info/Help
- Language Select

In the section that follows, the applicable security level for each menu option is indicated as follows:



Administrative



Service





User

Options that can be set at Quick Setup are indicated with: 

The factory default values are shown, enclosed in brackets.

**Note: Options that are listed [Factory Set] should not be changed without specific directions from authorized Badger Meter personnel.**

| Meter Setup  |   |
|--|---|
| <b>Scale Factor</b><br>[0.0%]<br>     | <p>Changing the scale factor lets you adjust the meter's accuracy without disturbing factory-set parameters. You can tune the meter to meet changing application requirements. For example, if the meter is under registering by 0.5 percent then set the scale factor to +0.5%. If the meter is over registering by 0.5 percent then set the scale factor to -0.5%.</p> <p>To set the Scale Factor, follow these steps from the <b>Meter Setup</b> menu:</p> <ol style="list-style-type: none"> <li>1. Select <b>Scale Factor</b>, to open the Detector Factor display.</li> <li>2. Set the Detector Factor value to the desired setting.</li> <li>3. Press <b>[E]</b>, to save the new value and return to the Meter Setup menu.</li> </ol> |
| <b>Empty Pipe Detect</b><br>[Off]<br> | <p>When set to On, Empty Pipe Detect indicates to the outputs and the display that the meter is not completely filled. When set to Off, empty pipe detect is disabled.</p> <p>Enabling empty pipe detect requires a one-time calibration. Calibration is described in the Advance Menu section under Empty Pipe Cal.</p> <p>To set Empty Pipe Detect, follow these steps from the <b>Meter Setup</b> menu:</p> <ol style="list-style-type: none"> <li>1. Select <b>Empty Pipe Detect</b> to view the Empty Pipe Detect display.</li> <li>2. Position the arrow next to <b>On</b> or <b>Off</b>.</li> <li>3. Press <b>[E]</b> to save the Empty Pipe Detect On or Off and return to the Meter Setup menu.</li> </ol>                           |

## Meter Setup

### Power Line Freq

[60 Hz]



This parameter provides measuring immunity to industrial noise from a power supply feed.

To set Power Line Frequency, follow these steps from the **Meter Setup menu**:

1. Select **Power Line Freq** to view the Power Line Frequency display.
2. Position the arrow next to **50 Hz** or **60 Hz**.
3. Press **[E]** to save the power line frequency and return to the Meter Setup menu.

### Excitation Freq

[Factory Set]



This parameter is set at the factory. You can change Excitation Freq to configure the DC excitation of the coils. Supported frequencies are dependent on the configured power line frequency:

| 50 Hz    | 60 Hz   |
|----------|---------|
| 1 Hz     | 1 Hz    |
| 3.125 Hz | 3.75 Hz |
| 6.25 Hz  | 7.5 Hz  |
| 12.5 Hz  | 15 Hz   |

To change Excitation Frequency, follow these steps from the **Meter Setup menu**:

1. Select **Excitation Freq** to view the Excitation Frequency display.
2. Position the arrow next the desired frequency.
3. Press **[E]** to save the excitation frequency and return to the Meter Setup menu.

### Pipe Diameter

[Factory Set]



This parameter is set at the factory. In the event the amplifier is replaced, verify that the pipe diameter matches the installed pipe size.



To change Pipe Diameter, follow these steps from the **Meter Setup menu**:

1. Select **Pipe Diameter** to open the Pipe Diameter display.
2. Position the arrow next to one of the following pipe diameters.

|               |               |             |              |
|---------------|---------------|-------------|--------------|
| 6mm [1/4"]    | 65mm [2 1/2"] | 400mm [16"] | 1000mm [40"] |
| 8mm [1/4"]    | 80mm [3"]     | 450mm [18"] | 1050mm [42"] |
| 10mm [1/4"]   | 100mm [4"]    | 500mm [20"] | 1200mm [48"] |
| 15mm [1/4"]   | 125mm [5"]    | 550mm [22"] | 1400mm [54"] |
| 20mm [1/4"]   | 150mm [6"]    | 600mm [24"] | 1600mm [64"] |
| 25mm [1"]     | 200mm [8"]    | 700mm [28"] | 1800mm [72"] |
| 32mm [1 1/4"] | 250mm [10"]   | 750mm [30"] | 2000mm [80"] |
| 40mm [1 1/2"] | 300mm [14"]   | 800mm [32"] | Other        |
| 50mm [2"]     | 350mm [14"]   | 900mm [36"] |              |

3. Press **[E]** to save the pipe diameter and return to the Meter Setup menu.



## Meter Setup

|  |   |
|--|---|
| <b>Detector Factor</b><br>[Factory Set]<br> | <p>This parameter is set at the factory. This factor compensates for accuracy error as a result of the installed detector. If accuracy adjustment of the meter is required, please refer to the scale factor.</p> <p>In the event the amplifier is replaced, this parameter must be reprogrammed with the original detector factor.</p> |
| <b>Detector Offset</b><br>[Factory Set]<br> | <p>This parameter is set at the factory. This parameter compensates for accuracy error as a result of the installed detector. If accuracy adjustment of the meter is required, please refer to the scale factor.</p>  |

## Measurements

Flow Units

[GPM]

Flow Units lets you set the unit of measure for the flow rate and full scale flow. Changing the flow units parameter readjusts the full scale flow parameter. For example, changing from GPM to GPS would change the full scale flow from 60 GPM to 1 GPS.

To change the Flow Unit, follow these steps from the **Measurements menu**:

1. Select **Flow Units** to view the Flow Units display.
2. Position the arrow next to one of the following flow unit options:

| Code | Flow Unit        | Code | Flow Unit      |
|------|------------------|------|----------------|
| LPS  | Liter/Second     | GPM  | Gallons/Min.   |
| LPM  | Liter/Minute     | GPH  | Gallons/Hour   |
| LPH  | Liter/Hour       | MGD  | MegaGallon/Day |
| M3S  | Cubic Meter/Sec. | IGS  | UKG/Sec.       |
| M3M  | Cubic Meter/Min. | IGM  | UKG/Min.       |
| M3H  | Cubic Meter/Hour | IGH  | UKG/Hour       |
| F3S  | Cubic Feet/Sec.  | LbM  | Pound/Min.     |
| F3M  | Cubic Feet/Min.  | OPM  | Ounce/Min      |
| F3H  | Cubic Feet/Hour. | BPM  | Barrel/Min     |
| GPS  | Gallons/Sec.     |      |                |

3. Press **[E]** to save the flow units and return to the Measurements menu.

## Measurements

### Totalizer Unit

[USG]



This parameter establishes the units of measure for the totalizers.

To change the Totalizer Unit value, follow these steps from the **Measurements menu**:

1. Select **Totalizer Unit** to view the Totalizer Unit display.
2. Position the arrow next to one of the following totalizer units:

| <i>Code</i> | <i>Totalizer Unit</i> | <i>Code</i> | <i>Totalizer Unit</i> |
|-------------|-----------------------|-------------|-----------------------|
| L           | Liters                | UKG         | Imperial Gallons      |
| HL          | HectoLiters           | Lb          | Pounds                |
| M^3         | Cubic Meters          | Oz          | Fluid Ounces          |
| CFt         | Cubic Feet            | Aft         | Acre Feet             |
| USG         | U.S. Gallons          | BBL         | Barrel                |
| MG          | MegaGallons           |             |                       |

3. Press **[E]** to save the totalizer unit and return to the Measurements menu.

### Full Scale Flow

[Factory Set]



This parameter sets the maximum flow the system is expected to measure. This parameter has influence on other system parameters. These parameters include:

- Frequency Output – Full scale frequency is observed at full scale flow
- Low Flow Cutoff – Changes to full scale flow affect the measuring cut-off threshold of the meter
- Alarm Outputs – Changes to full scale flow adjusts the thresholds for generating set point alarms
- Pulse Outputs – Changes to full scale flow adjusts the pulse frequency and duty cycle
- Analog Outputs – Changes to full scale flow adjusts the interpretation of the analog output signal




Change the full scale flow based on the meter size and the application's requirements. Verify that the full scale flow falls within the meter's suggested flow range limits. In terms of flow velocity, the meter's limits are from 0.1 to 39.4 feet/second.



The full scale flow is valid for both flow directions.



**Note: If the flow rate exceeds the full scale setting, an error message indicates that the configured full scale range has been exceeded. However, the meter will continue to measure. This will affect the latency of the pulse outputs and possibly cause overflow. Furthermore, the analog output may also be placed in alarm mode.**




To change the Full Scale Flow, follow these steps from the **Measurements menu**:




1. Select **Full Scale Flow** to view the Full Scale Flow display.
2. Set the full scale flow value to the desired setting.
3. Press **[E]** to save the full scale flow value and return to the Measurements menu.




| Measurements  |   |          |            |           |            |           |            |           |              |           |  |
|---|---|----------|------------|-----------|------------|-----------|------------|-----------|--------------|-----------|--|
| <p><b>Low Flow Cutoff</b><br/>[0.2%]</p>           | <p>Low flow cutoff defines the threshold at which flow measurement will be forced to zero. The cutoff value can be set from 0% to 10% of the full scale flow. Increasing this threshold will help prevent false readings during “no flow” conditions possibly caused by pipe vibration or inherent system noise.</p> <p>To change the Low Flow Cutoff value, follow these steps from the <b>Measurements menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Low Flow Cutoff</b> to view the Low Flow Cutoff display.</li> <li>2. Set the low flow cutoff value to the desired setting.</li> <li>3. Press <b>[E]</b> to save the new low flow cutoff value.</li> </ol>  |          |            |           |            |           |            |           |              |           |  |
| <p><b>Flow Direction</b><br/>[Bi-Directional]</p>  | <p>Flow direction lets you set the meter to measure forward flow only (uni-directional) or both forward and reverse flow (bi-directional).</p> <p><b>Uni-Directional</b></p> <p>Flow is totaled in only one direction. The flow direction is indicated by the arrow printed on the detector label. Uni-directional measurements on the main display screen include:</p> <ul style="list-style-type: none"> <li>• T1: Registers forward flow, resettable by menu or Modbus RTU</li> <li>• T2: Registers forward flow, resettable by menu, Modbus RTU, or digital input configured for Remote Reset</li> </ul> <p><b>Bi-Directional</b></p> <p>Flow is totaled in both directions. Bi-directional measurements on the main display screen include:</p> <ul style="list-style-type: none"> <li>• T+: Registers forward flow, resettable by menu or Modbus RTU</li> <li>• T-: Registers reverse flow, resettable by menu or Modbus RTU</li> <li>• TN: Registers total flow, T+ - T-, resettable by menu or Modbus RTU</li> </ul> <p>To change the flow direction follow these steps from the <b>Measurements menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Flow Direction</b> to view the Flow Direction display.</li> <li>2. Select <b>Uni-Directional</b> or <b>Bi-Directional</b>.</li> <li>3. Press <b>[E]</b> to save the flow direction and return to the Measurements menu.</li> </ol> |          |            |           |            |           |            |           |              |           |  |
| <p><b>Damping Factor</b><br/>[No Damping]</p>    | <p>The damping factor establishes the stability of the measured flow rate. If back and forth oscillations of the flow rate are observed during normal flow conditions, increase this value incrementally until the flow rate stabilizes. This parameter has no affect on the totalizers.</p> <p>To change the Damping Factor value, follow these steps from the <b>Measurements menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Damping Factor</b> to view the Damping Factor display.</li> <li>2. Select one of the following damping factors: <table data-bbox="435 1654 805 1871"> <tr> <td>1 Second</td><td>10 Seconds</td></tr> <tr> <td>2 Seconds</td><td>20 Seconds</td></tr> <tr> <td>3 Seconds</td><td>30 Seconds</td></tr> <tr> <td>4 Seconds</td><td>No Dampening</td></tr> <tr> <td>5 Seconds</td><td></td></tr> </table> </li> <li>3. Press <b>[E]</b> to save the damping factor and return to the Measurements menu.</li> </ol>  | 1 Second | 10 Seconds | 2 Seconds | 20 Seconds | 3 Seconds | 30 Seconds | 4 Seconds | No Dampening | 5 Seconds |  |
| 1 Second  | 10 Seconds  |          |            |           |            |           |            |           |              |           |  |
| 2 Seconds   | 20 Seconds  |          |            |           |            |           |            |           |              |           |  |
| 3 Seconds   | 30 Seconds  |          |            |           |            |           |            |           |              |           |  |
| 4 Seconds   | No Dampening  |          |            |           |            |           |            |           |              |           |  |
| 5 Seconds   |   |          |            |           |            |           |            |           |              |           |  |








| Inputs/Outputs |   |  |
|----------------|---|--|
| Analog Output  | <b>Range</b><br>[4 to 20 mA]<br>   | <p>This parameter establishes the range of the analog output signal. To change Analog Output range, follow these steps from the <b>Inputs/Outputs menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Analog Output</b> to view the Analog Output display.</li> <li>2. Select one of the following options:               <ul style="list-style-type: none"> <li>• 4 to 20 mA</li> <li>• 0 to 20 mA</li> <li>• 2 to 10 mA</li> <li>• 0 to 10 mA</li> </ul> </li> <li>3. Press <b>[E]</b> to save the analog output and return to the Inputs/Outputs menu.</li> </ol>   |
|                | <b>Alarm Mode</b><br>[HIGH]<br>  | <p>This parameter configures the behavior of the analog output during alarm conditions. Three options exist for this parameter: <b>OFF, LOW, and HIGH</b>.</p> <p><b>OFF:</b> Analog signal is based on flow rate and always within the configured range</p> <p><b>LOW:</b> During alarm conditions, the analog signal will be 2mA less than the configured lower range</p> <p><b>HIGH:</b> During alarm conditions, the analog signal will be 2mA more than the configured upper range</p> <p>For example, if the analog range is 4 to 20 mA and the alarm mode is set to HIGH, then during a full scale flow alarm condition, the analog output current will be 22 mA.</p> <p>To change the analog output alarm mode, follow these steps from the Inputs/Outputs menu:</p> <ol style="list-style-type: none"> <li>1. Select <b>Alarm Mode</b> to view the Alarm Mode display.</li> <li>2. Select one of the following options:               <ul style="list-style-type: none"> <li>• OFF</li> <li>• LOW</li> <li>• HIGH</li> </ul> </li> <li>3. Press <b>[E]</b> to save the alarm mode and return to the Inputs/Outputs menu.</li> </ol> |
| Digital Input  | <p>Digital input lets you configure the functional operation of the digital input. The following functions are supported:</p> <ul style="list-style-type: none"> <li>• Remote Reset – Clears totalizer T2 (uni-directional)</li> <li>• Batch Reset – Resets batch totalizer PS to preset amount and clears T2 (uni-directional)</li> <li>• Pos Zero Return – Forces flow rate to zero (does not totalize)</li> </ul> <p>To change Digital Input, follow these steps from the <b>Inputs/Outputs menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Digital Input</b> to view the Digital Input display.</li> <li>2. Select the desired function.</li> <li>3. Press <b>[E]</b> to save the digital input and return to the Inputs/Outputs menu.</li> </ol> |  |


| Inputs/Outputs |   |  |
|----------------|---|--|
| Digital Output | <b>Pulses/Unit</b><br>[1]<br>      | <p>The Pulses/Unit parameter lets you set how many pulses per unit of measure will be transmitted to remote applications. For example, assuming the unit of measure is gallons:</p> <ul style="list-style-type: none"> <li>Setting the Pulses/Unit to 1 will transmit 1 pulse every gallon</li> <li>Setting the Pulses/Unit to 0.01 will transmit 1 pulse every 100 gallons</li> </ul> <p>You must configure pulses/unit if the function of the selected output is to be forward, reverse or AMR pulse.</p> <p>This parameter must be considered with the Pulse Width and Full Scale Flow parameters. The maximum pulse frequency is 10 kHz. The frequency is correlated with the flow rate. Violation of output frequency limits will generate a configuration error.</p> <p>To change the pulses/unit, follow these steps from the <b>Inputs/Outputs menu</b>:</p> <ol style="list-style-type: none"> <li>Select <b>Digital Output 1 or 2</b> and press <b>[E]</b> to open the Digital Output menu.</li> <li>From the <b>Digital Output menu</b> select <b>Pulses/Unit</b>, and press <b>[E]</b> to open the Pulses/Unit display.</li> <li>Enter the pulses/unit value. Press <b>[E]</b> to save the new parameter and return to the Digital Output menu.</li> </ol>   |
|                | <b>Pulse Width</b><br>[0 ms]<br> | <p>This parameter establishes the On duration of the transmitted pulse. The configurable range is from 0 to 1000 ms.</p> <ul style="list-style-type: none"> <li>Non-zero pulse width configuration – the Off duration of the transmitted pulse is dependent on flow rate. The Off duration is to be at least the configured On duration. At full scale flow, the On duration equals the Off duration. The maximum configurable output frequency is limited to 500 Hz.</li> <li>0 ms pulse width configuration – the duty cycle of the transmitted pulse is at 50 percent allowing for a maximum configurable output frequency of 10 kHz.</li> </ul> <p>This parameter must be considered with the Pulses/Unit and Full Scale Flow parameters. The maximum pulse frequency is 10 kHz. The frequency is correlated with the flow rate. Violation of output frequency limits will generate a configuration error.</p> <p>To change the pulse width, follow these steps from the <b>Inputs/Outputs Menu</b>:</p> <ol style="list-style-type: none"> <li>Select <b>Digital Output 1 or 2</b> and press <b>[E]</b> to open the Digital Output menu.</li> <li>From the <b>Digital Output menu</b> select <b>Pulse Width</b>, and press <b>[E]</b> to open the Pulse Width display.</li> <li>Enter the pulse width value. Press <b>[E]</b> to save the new parameter and return to the Digital Output menu.</li> </ol> |

| Inputs/Outputs |  |  |
|----------------|--|--|
| Digital Output | <b>Preset Amount</b><br>[0.0]<br>     | <p>Preset amount lets you set the reset value for the associated PS totalizer when the digital input is set to Batch Reset.</p> <p>To change the preset amount, follow these steps from the <b>Inputs/Outputs Menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Digital Output 1, 2, 3 or 4</b> and press [E] to open the Digital Output menu.</li> <li>2. From the <b>Digital Output menu</b> select <b>Preset Amount</b>, and press [E] to open the Preset Amount display.</li> <li>3. Enter the preset amount value. Press [E] to save the new parameter and return to the Digital Output menu.</li> </ol> <p><b>Note: You can only set one Preset Amount. If you set the Preset Amount for Digital Output 1, it will be the same for 2, 3 and 4.</b></p> |
|                | <b>Set Point Min.</b><br>[0%]<br>     | <p>This parameter establishes, as a percentage of full scale flow, the threshold at which the output alarm will be activated. Flow rates below the threshold will activate the output alarm.</p> <p>To change the set point minimum, follow these steps from the <b>Inputs/Outputs Menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Digital Output 1, 2, 3 or 4</b> and press [E] to open the Digital Output menu.</li> <li>2. From the <b>Digital Output menu</b> select <b>Set Point Min.</b>, and press [E] to open the Set Point Min. display.</li> <li>3. Enter the set point minimum value. Press [E] to save the new parameter and return to the Digital Output menu.</li> </ol>   |
|                | <b>Set Point Max.</b><br>[100%]<br> | <p>This parameter establishes, as a percentage of full scale flow, the threshold at which the output alarm will be activated. Flow rates above the threshold will activate the output alarm.</p> <p>To change the maximum set point, follow these steps from the <b>Inputs/Outputs Menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Digital Output 1, 2, 3 or 4</b> and press [E] to open the Digital Output menu.</li> <li>2. From the <b>Digital Output menu</b> select <b>Set Point Max.</b>, and press [E] to open the Set Point Max. display.</li> <li>3. Enter the set point maximum value and press [E] to save the new parameter and return to the Digital Output menu.</li> </ol>  |





| Inputs/Outputs        |   |   |
|-----------------------|---|---|
| <b>Digital Output</b> | <b>Output Type</b><br>[1: Normally Open]<br>[2: Normally Open]<br>[3: Normally Open]<br>[4: Normally Closed]<br> | <p>The Output Type parameter lets you set the output switch to normally open or normally closed. If normally open is selected, the output switch is open (no current) when the output is inactive, and closed (current flows) when the output is active.</p> <p>If normally closed is selected, the output switch is closed (current flows) when the output is inactive, and open (no current) when the output is active.</p> <p>To change the Output Type, follow these steps from the <b>Inputs/Outputs Main Menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Digital Output 1, 2, 3 or 4</b> and press [E] to open the Digital Output menu.</li> <li>2. From the <b>Digital Output menu</b>, select <b>Output Type</b>, and press [E] to open the Output Type display.</li> <li>3. Select <b>Normally Open</b> or <b>Normally Closed</b>.</li> <li>4. Press [E] to save the new parameter and return to the Digital Output menu.</li> </ol> |
|                       | <b>Hardware Type</b><br>[3: Open Collector]<br>[4: Open Collector]<br>   | <p>The hardware type parameter lets you select the type of hardware used to drive the output signal: either open collector or solid-state relay.</p> <p>To change the Hardware Type, follow these steps from the <b>Inputs/Outputs Main Menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Digital Output 3 or 4</b> and press [E] to open the Digital Output menu.</li> <li>2. From the <b>Digital Output menu</b> select <b>Hardware Type</b>, and press [E] to open the Hardware Type display.</li> <li>3. Select <b>Open Collector</b> or <b>Relay</b>.</li> <li>4. Press [E] to save the new parameter and return to the Digital Output menu.</li> </ol>  |
|                       | <b>Full Scale Frequency</b><br>[3: 1000 Hz]<br>  | <p>This parameter establishes the full scale flow output frequency when the flow rate equals the configured full scale flow.</p> <p>To change the Full Scale Frequency, follow these steps from the <b>Inputs/Outputs Main Menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Digital Output 3</b> and press [E] to open the Digital Output menu.</li> <li>2. From the <b>Digital Output menu</b> select <b>Full Scale Frequency</b>, and press [E] to open the Full Scale Frequency display.</li> <li>3. Set the full scale frequency value to the desired setting.</li> <li>4. Press [E] to save the new parameter and return to the Digital Output menu.</li> </ol>   |

| Inputs/Outputs   |  |   |
|--|--|---|
| <b>Digital Output</b><br><br>[1: Forward Pulse]<br>[2: Reverse Pulse]<br>[3: Frequency Pulse]<br>[4: Error Alarm]<br><br> | <b>Select Function</b><br><br>[1: Forward Pulse]<br>[2: Reverse Pulse]<br>[3: Frequency Pulse]<br>[4: Error Alarm]<br><br>  | <p>Digital Output lets you configure the functional operation of the associated output. The following operations are supported:</p> <ul style="list-style-type: none"> <li>Reverse Pulse – Generates pulses during reverse flow conditions</li> <li>Forward Pulse – Generates pulses during forward flow conditions</li> <li>Frequency Output – Generates pulses correlated to the absolute value of the flow rate</li> <li>Preset Output – Provides indication when preset batch amount has been realized</li> <li>Flow Set Point – Provides indication when flow rate exceeds thresholds defined by flow set points</li> <li>24 Vdc Supply – Provides constant 24 volts on output (forces output type to normally open)</li> <li>Error Alarm – Provides indication when meter has error condition. Error conditions include, empty pipe error, full scale flow error, and detector error</li> <li>Flow Direction – Provides indication on current flow direction (Inactive = Reverse or No Flow, Active = Forward)</li> <li>Empty Pipe Alarm – Provides indication when pipe is empty</li> </ul> <p>To change the Function Select, follow these steps from the <b>Inputs/Outputs Main Menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Digital Output 1, 2, 3 or 4</b> and press [E] to open the Digital Output menu.</li> <li>2. From the <b>Digital Output menu</b> choose <b>Select Function</b>, and press [E] to open the Select Function display.</li> <li>3. Select the desired function.</li> <li>4. Press [E] to save and return to the Digital Output menu.</li> </ol> |
| <b>Flow Simulation</b><br><br>[Off]<br><br>   | <p>Flow Simulation provides output simulation based on a percentage of the full scale flow. Simulation will not accumulate the totalizers. The range of simulation includes -100% to 100% of the full scale flow.</p> <p>The Flow Simulation Parameter lets you set the range of simulation in 10% increments.</p> <p>To change the Flow Simulation, follow these steps from the <b>Inputs/Outputs menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Flow Simulation</b> to view the Flow Simulation display.</li> <li>2. Click [+] to increment the percentage by 10, or click [-] to decrement the percentage by 10.</li> <li>3. Press [E] to save the displayed setting and return to the Inputs/Outputs menu.</li> </ol> |   |

| Clear Totals   |   |
|--|---|
| <b>T1</b><br>       | The uni-directional totalizer is reset within the the menu manager or through remote communications. Clearing T1 also clears the associated rollover counter.   |
| <b>T2</b><br>       | The uni-directional totalizer is reset within the the menu manager, through remote communications or with properly-configured digital input (function = remote reset). Clearing T2 also clears the associated rollover counter.                         |
| <b>T+</b><br>       | The bi-directional forward flow totalizer is reset within the the menu manager or through remote communications. Clearing T+ also clears the associated rollover counter.   |
| <b>T-</b><br>       | The bi-directional reverse flow totalizer is reset within the the menu manager or through remote communications. Clearing T- also clears the associated rollover counter.   |
| <b>Tn</b><br>       | The bi-directional net totalizer, when reset, clears both the forward and the reverse flow totalizers (T+ and T-). This is reset within the the menu manager or through remote communications. Clearing Tn also clears the associated rollover counter. |
| <b>PS</b><br>     | The batch totalizer is reset to the configured preset amount value. It is reset within the menu manager, remote communications or through a properly-configured digital input (function = batch reset).   |
| <b>Tpwoff</b><br> | The totalizer accumulating meter time without external power is reset with the menu manager or through remote communications.   |

| Communication: Port Settings  |  |
|---|--|
| <b>Interface</b><br>[Modbus RTU]<br> | <p>The Interface parameter lets you configure how the RS232 communication port will be used.</p> <ul style="list-style-type: none"> <li>• Modbus RTU</li> <li>• Remote menu (RDI - Remote Display Interface)</li> <li>• Disable port</li> </ul> <p>The remote menu interface will check for display updates once a second. If a change is detected, the display contents will be transmitted in ASCII format over the RS232 communication port. The remote menu interface also allows for menu navigation and control of the meter as if using the external push buttons. Keyboard control characters such as &lt;UP&gt;, &lt;DWN&gt;, and &lt;ENTER&gt; are supported to navigate the menus.</p> <p>To change the Interface follow these steps from the <b>Port A Settings menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Interface</b> to view the Interface display.</li> <li>2. Select the desired interface.</li> <li>3. Press <b>[E]</b> to save and return to the Port A Settings menu.</li> </ol> |

## Communication: Port Settings

|   |   |
|---|---|
| <b>Port Address</b><br>[1]<br>     | <p>This parameter establishes the Modbus RTU address. Modbus RTU requests will only be processed if the configured port address of the meter matches the request address found in the Modbus RTU packet. The range of addresses supported by Modbus RTU is 1-247. Modbus RTU request packets with an address of 0 imply the packet is to be treated as a broadcast packet.</p> <p>To change the port address, follow these steps from the <b>Port A Settings menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Port Address</b> to view the port address display.</li> <li>2. Select the desired port address (<b>1-247</b>).</li> <li>3. Press <b>[E]</b> to save the option and to return to the Port A Settings menu.</li> </ol> |
| <b>Baud Rate</b><br>[9600]<br>     | <p>The following baud rates are supported</p> <ul style="list-style-type: none"> <li>• 9600</li> <li>• 19200</li> <li>• 38400</li> </ul> <p>To change the baud rate, follow these steps from the <b>Port A Settings menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Baud Rate</b> to view the Baud Rate display.</li> <li>2. Select one of the following baud rates: <b>9600</b>, <b>19200</b> or <b>38400</b>.</li> <li>3. Press <b>[E]</b> to save the option and to return to the Port A Settings menu.</li> </ol>   |
| <b>Parity</b><br>[Even]<br>      | <p>The following parities are supported</p> <ul style="list-style-type: none"> <li>• Even</li> <li>• Odd</li> <li>• None</li> </ul> <p>To change the parity, follow these steps from the <b>Port A Settings menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Parity</b> to view the Parity display.</li> <li>2. Select one of the following: <b>None</b>, <b>Even</b> or <b>Odd</b>.</li> <li>3. Press <b>[E]</b> to save the option and to return to the Port A Settings menu.</li> </ol>   |
| <b>Data Bits</b><br>[8 bits]<br> | <p>This parameter configures the port data bits. The following data bits are supported</p> <ul style="list-style-type: none"> <li>• 8 bits</li> <li>• 7 bits</li> <li>• 5 bits</li> </ul> <p>To change the data bits, follow these steps from the <b>Port A Settings menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Data Bits</b> to view the Data Bits display.</li> <li>2. Select one of the following: <b>8 Bits</b>, <b>7 Bits</b> or <b>5 Bits</b>.</li> <li>3. Press <b>[E]</b> to save the option and to return to the Port A Settings menu.</li> </ol>   |

### Communication: Port Settings

#### Stop Bits

[1 Stop Bit]



This parameter configures the port stop bits. The following stop bits are supported:

- 1 Stop Bit
- 2 Stop Bits

To change the stop bits, follow these steps from the **Port A Settings** menu:

1. Select **Stop Bits** to view the Stop Bits display.
2. Select one of the following: **1 Stop Bit**, or **2 Stop Bits**.
3. Press **[E]** to save the option and to return to the Port A Settings menu.

### Communication: Diagnostics

#### Port Counters

[0]



Port counters are used for diagnostics when configured for Modbus RTU. These counters are only cleared on power up.

| Counter        | Description   |
|----------------|---|
| Pkts Processed | Number of packets processed by meter.   |
| Broadcast Pkts | Number of broadcast packets (address = 0) processed by meter.   |
| CRC Errors     | Number of received packets with CRC error; packet is discarded.   |
| Pkts Rcvd      | Number of packets received with an address of the configured port address.  |
| Pkts Sent      | Number of packets transmitted in response to a received packet.   |
| Parity Errors  | Number of characters with parity errors ( <i>i.e.</i> , received character has a mismatch between the number of 1s and its parity bit); packet is discarded.  |
| Framing Errors | Number of characters with framing errors ( <i>i.e.</i> missing stop bit is not found – indicates that synchronization with the start bit has been lost and that the character is improperly framed); packet is discarded. |
| Overrun Errors | Number of characters received that were not processed due to degradation of system performance.   |
| Break Detects  | Number of detections that transmission line is locked ( <i>i.e.</i> , receive line is low for 10-bit transmissions following a missing stop bit).   |

## Advanced

**Unit Multiplier**

[Off]



This Unit Multiplier establishes the number of units of measure that have to accumulate before the display totalizers are updated. This is also known as setting the number of "dead" zeroes in the display totalizer. For example:

| Unit Multiplier less than 1 |             |             |             |             |             |
|-----------------------------|-------------|-------------|-------------|-------------|-------------|
| Unit Multiplier             | Example     |             |             |             |             |
| OFF                         | 0.00000 USG | 0.00012 USG | 0.00123 USG | 0.01234 USG | 0.12345 USG |
| 0.0001                      | 0.0000 USG  | 0.0001 USG  | 0.0012 USG  | 0.0123 USG  | 0.1234 USG  |
| 0.001                       | 0.000 USG   | 0.000 USG   | 0.001 USG   | 0.012 USG   | 0.123 USG   |
| 0.01                        | 0.00 USG    | 0.00 USG    | 0.00 USG    | 0.01 USG    | 0.12 USG    |
| 0.1                         | 0.0 USG     | 0.0 USG     | 0.0 USG     | 0.0 USG     | 0.1 USG     |

| Unit Multiplier greater than or equal to 1 |             |             |              |              |             |
|--|-------------|-------------|--------------|--------------|-------------|
| Unit Multiplier                            | Example     |             |              |              |             |
| OFF  | 0.00000 USG | 1.23456 USG | 12.34567 USG | 123.4567 USG | 1234.56 USG |
| 1  | 0 USG       | 1 USG       | 12 USG       | 123 USG      | 1234 USG    |
| 10   | 0 USG       | 0 USG       | 10 USG       | 120 USG      | 1230 USG    |
| 100  | 0 USG       | 0 USG       | 0 USG        | 100 USG      | 1200 USG    |
| 1000                                       | 0 USG       | 0 USG       | 0 USG        | 0 USG        | 1000 USG    |

To change the Unit Multiplier, follow these steps from the **Advanced menu**:

1. Select **Unit Multiplier** to view the Unit Multiplier display.
2. Select the desired unit multiplier.
3. Press **[E]** to save the option and to return to the Advanced menu.

**Backlight Control**

[Timed Off]








You can set the meter's backlight to: Always On, Always Off and Timed Off.



When set to Timed Off, the backlight will automatically turn off after one minute of inactivity (no buttons pressed). Pressing any button will turn the backlight on, but will not immediately navigate the menu.

To change the backlight control, follow these steps from the **Advanced menu**:

1. Select **Backlight Control** to view the Backlight Control display.
2. Select the desired option.
3. Press **[E]** to save the option and to return to the Advanced menu.

| Advanced         |   |  |
|------------------|---|--|
| Analog Calibrate | <b>Custom Settings</b><br>[Zero Scale: 0 mA]<br>[Full Scale: 0 mA]<br> | Scale/Full Scale offsets on site.<br><br>To set the analog calibration custom settings, follow these steps from the <b>Advanced menu</b> : <ol style="list-style-type: none"> <li>1. Select <b>Analog Calibrate</b> to view the Analog Calibrate menu.</li> <li>2. Select <b>Custom Settings</b> to view the Custom Settings display.</li> <li>3. Select one of the following:               <ul style="list-style-type: none"> <li>• <b>Offset 4 mA</b></li> <li>• <b>Offset 20 mA</b></li> </ul> </li> <li>4. Configure desired offset.</li> <li>5. Press <b>[E]</b> to save the option and to return to the Custom Settings menu.</li> <li>6. Press <b>[E]</b> to return to the Analog Calibrate menu.</li> </ol>             |
|                  | <b>Factory Settings</b><br>[Factory Set]<br>                           | To change the analog calibration factory settings, follow these steps from the <b>Advanced menu</b> : <ol style="list-style-type: none"> <li>1. Select <b>Analog Calibrate</b> to view the Analog Calibrate menu.</li> <li>2. Select <b>Factory Settings</b> to view the Factory Settings display.</li> <li>3. Select one of the following:               <ul style="list-style-type: none"> <li>• <b>Calibration Point A</b></li> <li>• <b>Calibration Point B</b></li> </ul> </li> <li>4. Set the calibration point to the measured output current.</li> <li>5. Press <b>[E]</b> to save the option and to return to the Custom Settings menu.</li> <li>6. Press <b>[E]</b> to return to the Analog Calibrate menu.</li> </ol> |

| Advanced        |  |  |
|-----------------|--|--|
| Software Filter | <b>Description</b>   | The software filter operates as an acceleration filter. This filter when configured properly allows for filtering of fast changes in fluid flow. Generally, this filter is used in applications having highly conductive fluids. This filter is intended to help provide smoothing of the analog output and display fluctuations.  |
|                 | <b>Activation</b><br>[Off]<br>          | This parameter setting enables or disables the software acceleration filter.<br><br>To change the Activation setting, follow these steps from the <b>Advanced menu</b> : <ol style="list-style-type: none"> <li>1. Select <b>Activation</b> from the Advanced menu.</li> <li>2. Select the desired setting.</li> <li>3. Press <b>[E]</b> to save the option and to return to the Advanced menu.</li> </ol>   |
|                 | <b>Filter Delay</b><br>[1]<br>          | Filter Delay lets you set the amount of time that the flow will be held constant once the filter is activated. The filter is activated by an acceleration component of the fluid exceeding the configured limit.<br><br>To change the Filter Delay follow these steps from the <b>Advanced menu</b> : <ol style="list-style-type: none"> <li>1. Select <b>Filter Delay</b>, from the Advanced menu.</li> <li>2. Select the desired setting.</li> <li>3. Press <b>[E]</b> to save the option and to return to the Advanced menu.</li> </ol>   |
|                 | <b>Acceleration Factor</b><br>[1]<br> | This parameter lets you set the maximum acceleration for a given pipe diameter and is dependent on the excitation frequency. The maximum fluid velocity is 12 m/s. The following equation defines the maximum fluid acceleration:<br><br>$\text{Acceleration(MAX)} = \text{Acceleration Factor} * 12 \text{ m/s} * \text{Pipe Area} * \text{Excitation Frequency} / 1.5.$ <p>If the realized fluid acceleration exceeds the configured maximum acceleration, fluid flow will be held constant for the time set at the Filter Delay parameter.</p> <p>To change the Acceleration Factor setting, follow these steps from the <b>Advanced menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Acceleration Factor</b> from the Advanced menu.</li> <li>2. Select the desired setting.</li> <li>3. Press <b>[E]</b> to save the option and to return to the Advanced menu.</li> </ol> |

| Advanced        |  |  |
|-----------------|--|--|
| Software Filter | <b>Constant Flow</b><br>[150 M <sup>3</sup> /Sec <sup>2</sup> ]<br> | <p>During normal flow conditions, there is always a non-zero acceleration component.</p> <p>For example, if acceleration of the flow activates the filter, the meter will assume constant flow for the duration of the filter delay time unless the flow returns within limits.</p> <p>Properly configured, this parameter will help offset excessive impacts of the filter delay. The Constant Flow parameter lets you set the acceleration limit for constant flow.</p> <p>To change the Constant Flow setting, follow these steps from the <b>Advanced menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Constant Flow</b> from the Advanced menu.</li> <li>2. Select the desired setting.</li> <li>3. Press <b>[E]</b> to save the option and to return to the Advanced menu.</li> </ol> |
|                 | <b>Peak Detect</b><br>[0 M <sup>3</sup> /Sec <sup>2</sup> ]<br>     | <p>Peak Detect offers a diagnostic view of the acceleration components observed during flow conditions. This parameter records the "high water mark" of the measured accelerations component. This value will help to properly configure the Acceleration Factor parameter. Generally, you will set the acceleration factor at about 75% of the Peak Detect measurement.</p> <p>To reset the Peak Detect setting, follow these steps from the <b>Advanced menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Peak Detect</b> from the Advanced menu.</li> <li>2. Press <b>[+]</b> to reset.</li> <li>3. Press <b>[E]</b> to return to the Advanced menu.</li> </ol>   |

## Advanced

**Empty Pipe Cal.**

[Default]



Fluid conductivity impacts the performance of empty pipe measurements. If you require empty pipe detection, you should perform this empty pipe calibration procedure.

Before starting the empty pipe calibration, verify that empty pipe detection is enabled. Also, run both the empty pipe and the full pipe calibration procedures.

**Calibrating an Empty Pipe**

Before calibrating an empty pipe, verify that the pipe is empty.

To calibrate with an empty pipe, follow these steps from the **Advanced menu**:

1. Select **Empty Pipe Cal** to view the calibration menus.
2. Select **Cal. Empty Pipe** to view the empty pipe calibration menu.
3. Enable calibration by placing the cursor on the calibration enable line and press **[E]**.

```
EMPTY PIPE CALIBRATE
Volts = 3.00
>Cal [ON]      E=OFF
Exit with Save
```

4. Wait 30 seconds for voltage measurement to stabilize.
5. Save setting by placing the cursor on Exit With Save menu line and press **[E]**.

**Calibrating a Full Pipe**




Before calibrating a full pipe, verify that the pipe is full.


To calibrate with a full pipe, follow these steps from the **Advanced menu**:






1. Select **Cal. Full Pipe** to view the calibration menus.
2. Select **Cal. Full Pipe** to view the full pipe calibration menu.
3. Enable calibration by placing the cursor on the calibration enable line and press **[E]**.



```
FULL PIPE CALIBRATE
Volts = 1.515
>Cal [OFF]     E=ON
Exit with Save
```


4. Wait 30 seconds for voltage measurement to stabilize.
5. Save setting by placing the cursor on Exit With Save menu line and press **[E]**.

| Advanced |  |  |
|----------|--|--|
| Security | <b>Set Admin PIN</b><br>[00000]<br>   | <p>Users logged in with this PIN will have access to all M-2000 procedures.</p> <p>To set the administrator's PIN, follow these steps from the <b>Advanced Menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Security</b> to view the Security menu.</li> <li>2. Select <b>Set Admin PIN</b> to view the Admin PIN display.</li> <li>3. Set the five-digit PIN number to the desired value.</li> <li>4. Press <b>[E]</b> to save the PIN and to return to the Security menu.</li> </ol>  |
|          | <b>Set Service PIN</b><br>[00000]<br> | <p>Users logged in with this PIN will have access to all service level and user-level procedures. Service users will not have access to administrative procedures.</p> <p>To set the service PIN, follow these steps from the <b>Advanced Menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Security</b> to view the Security menu.</li> <li>2. Select <b>Set Service PIN</b> to view the Service PIN display.</li> <li>3. Set the five-digit PIN number to the desired value.</li> <li>4. Press <b>[E]</b> to save the PIN and to return to the Security menu.</li> </ol> |
|          | <b>Set User PIN</b><br>[00000]<br>  | <p>Users logged in with this PIN will have access to user-level procedures. User at this level will not have access to administrative or service procedures.</p> <p>To set the user's PIN, follow these steps from the <b>Advanced Menu</b>:</p> <ol style="list-style-type: none"> <li>1. Select <b>Security</b> to view the Security menu.</li> <li>2. Select <b>Set User PIN</b> to view the User PIN display.</li> <li>3. Set the five-digit PIN number to the desired value.</li> <li>4. Press <b>[E]</b> to save the PIN and to return to the Security menu.</li> </ol>              |

| Info/Help   |                        |   |
|---|------------------------|---|
| <b>Error Counts</b><br>[0]<br> | <b>Description</b>     | This menu provides a diagnostic view of the meter's performance. Below are several system diagnostic counters and their definitions. Use discretion when interpreting these counters. These values could be altered during system setup or when using the verification device. We suggest that you reset these counters before you start monitoring your system and look for conditions possibly affecting performance. |
|   | <b>Detector</b>        | The number of times an invalid detector condition has been observed.  |
|   | <b>Empty Pipe</b>      | The number of times an empty pipe condition has been observed by the meter.   |
|   | <b>Full Scale</b>      | The number of times the flow has exceeded the full scale flow setting.  |
|   | <b>Totalizer</b>       | The number of times the totalizers have exceeded limits of the meter.   |
|   | <b>Pulse Sync.</b>     | The number of times the pulse outputs have fallen out of synchronization.   |
|   | <b>ADC Interrupt</b>   | The number of times an analog input measurement has been missed.  |
|   | <b>ADC Range</b>       | The number of times the analog input measurement range has been exceeded.   |
|   | <b>System Error</b>    | A diagnostic system message indicating the reason for a system reset.   |
|   | <b>System Resets</b>   | The number of times the meter has been reset.   |
|   | <b>System Reset ID</b> | Diagnostic information about a system reset as a result of expired internal timers.   |

| Info/Help   |  |
|---|--|
| <b>Rollover Counts</b><br>[0]<br>                | <p>The number of times the totalizers have rolled over 9,999,999,999 (10 billion).</p> <p>As the meter rolls over, a status indicator appears in the display. When this occurs, we suggest that you record the totalizers and rollover counter and reset the totalizers. Resetting totalizers will also clear the rollover counter.</p> <p>For a meter configured in bidirectional mode, rollover is represented by the net totalizer (TN) as "*****". During this condition, the net totalizer (TN) can be calculated using the following equation:</p> $T(\text{FWD}) = [(\text{ROLLOVER}_{T+} \times 10,000,000,000) + T+]$ $T(\text{REV}) = [(\text{ROLLOVER}_{T-} \times 10,000,000,000) + T-]$ $\text{TN} = T(\text{FWD}) - T(\text{REV})$ <p>Where <math>\text{ROLLOVER}_{T_x}</math> is the rollover count for the appropriate totalizer</p> <p>For a meter configured in unidirectional mode, the totalizer can be calculated using the following equation:</p> $T1 = [(\text{ROLLOVER}_{T1} \times 10,000,000,000) + T1]$ $T2 = [(\text{ROLLOVER}_{T2} \times 10,000,000,000) + T2]$ <p>Where <math>\text{ROLLOVER}_{T_x}</math> is the rollover count for the appropriate totalizer</p> |
| <b>PowerUp Counter</b><br>[Not applicable]<br> | <p>The number of times that the unit has been powered on.</p>  |
| <b>Power Off Time</b><br>[Not applicable]<br>  | <p>The length of time that the unit has been without power.</p>  |
| <b>Version Info</b><br>[Not applicable]<br>    | <p>The current software version.</p>   |
| <b>Serial Number</b><br>[Not applicable]<br>   | <p>The manufacturing serial number in the format YYMM####.</p> <p>Where YYMM indicates year and month of manufacturing and #### indicates the sequence number.</p>   |

| Info/Help   |   |
|---|---|
| <b>Restore Defaults</b><br>[Not applicable]<br>    | Restores all non-calibrated parameters to the factory defaults. |
| <b>Restore Calibration</b><br>[Not applicable]<br> | Restores the meter calibration as set at the factory.           |

| Language Select  |   |
|--|---|
| <b>Language Select</b><br>[English]<br> | <p>The M-2000 supports one alternate language along with English. This alternate language choice is set at the factory. The options are: Spanish, German, Czech or French.</p> <p>To select the language, follow these steps from the <b>Language Select</b> menu:</p> <ol style="list-style-type: none"><li>1. Press [<math>\uparrow</math>] or [<math>\downarrow</math>] to position the arrow/pointer next to either <b>English</b> or the <b>Alternate Language</b>.</li><li>2. Press [<b>E</b>] to save the selection.</li></ol> |

### Maintenance

Mandatory, routine or scheduled maintenance should not be required for the Badger M-2000 Mag Meter electronics or flow tube after proper installation.

However, some occurrences may require personnel to perform the following:

- Flow tube and electrode cleaning
- Fuse replacement
- Circuit board replacement

#### **WARNING**

These maintenance procedures are discussed in this section.

Disconnect main power to the unit before attempting any device maintenance or cleaning.

Do not clean components inside the amplifier or junction box.

### Cleaning the Flow Tube and Electrode

At times flow tube, electrodes, amplifier/junction box housings and the amplifier window may need periodic cleaning, depending on process fluid properties, fluid flow rate and surrounding environment.

Clean the flow tube and electrodes by following the material handling and cleaning procedures documented in Material Safety Data Sheet (MSDS) guidelines for the product(s) that were in contact with the flow tube and electrodes.

Should flow tube and/or electrode cleaning become necessary:

1. Disconnect detector from pipeline.
2. Clean electrodes according to MSDS guidelines.
3. Reconnect detector to pipeline.

### Replacing the Fuse

#### **WARNING**

Disconnect main power to the unit before attempting any device maintenance.

#### **CAUTION**

Risk of electrical shock. Replace the fuse only with 250 VAC, 2 amp, slow blow (5 x 20 mm).

Authorized personnel must replace fuses.

## Troubleshooting

The M-2000 mag meter is designed for many years of optimal performance. However, should it malfunction, there are certain things that we recommend you check before contacting our Technical Support department or your local Badger Meter Representative.

**Note: If the fluid measured has a high concentration of conductive solids, deposits may accumulate on the internal liner walls and electrodes. These deposits will cause a reduction of the measuring output. Thus, Badger Meter recommends that you remove the meter and inspect the liner and electrodes after six months. If deposits are found, remove them with a soft brush. Repeat inspection process every six months or until an appropriate inspection cycle can be established for the specific application.**

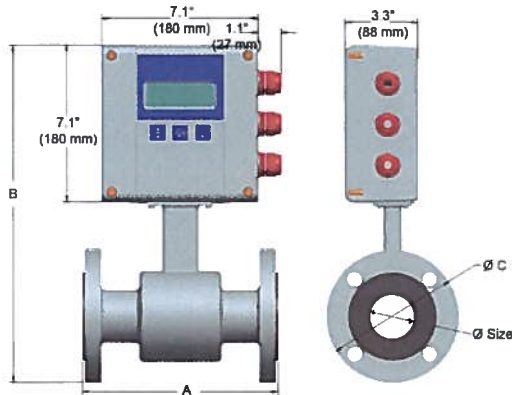
Other general conditions include:

| Description                        | Possible Cause  | Recommended Action   |
|------------------------------------|---|--|
| Flow is present but display is "0" | Digital input is holding flow.<br>Disconnected signal cable.<br>Detector mounted opposite of the main flow direction (see arrow on the nameplate).<br>Coil or electrode cables exchanged.<br>Improper low flow cutoff or full scale flow. | Check signal cable.<br>Turn detector by 180° or switch terminal E1 and E2 or reprogram to bidirectional mode.<br>Check cable connections for cross wiring.<br>Verify digital input configuration.<br>Replace configuration defaults.   |
| Inaccurate measuring               | Improper calibration.<br>Wrong calibration parameter.<br>Pipe not fully filled, or air in pipe.<br>Invalid fluid conductivity.<br>Invalid fluid mixture.  | Restore calibration defaults.<br>Check the parameters (detector factor and size) according to supplied data sheet.<br>Check if meter is completely filled with fluid.<br>Purge line to eliminate air bubbles.  |
| No display                         | No power.<br>Incorrect power.<br>Bad wiring connections.<br>Blown fuse.   | Apply power.<br>Check power value.<br>Replace fuse. (2 amp, 250 VAC, slow blow (5 x 20 mm)<br>Check display ribbon cable.  |
| Flow rate value known to be wrong  | Detector factor.<br>Deposits on electrodes and/or liner.<br>Incorrect pipe size programmed.   | Check value on label.<br>Check and remove deposits.<br>Check size if necessary.  |
| Flow rate indication unstable      | Cable issue.<br>Grounding issue.<br>Partially full pipe.<br>Air in pipe.<br>Amplifier location - outside electrical.<br>Invalid fluid conductivity.   | Make sure cable is shielded and not vibrating.<br>Make sure meter is properly grounded to a good earth ground.<br>Make sure pipe is full of fluid.<br>Make sure fluid does not contain air bubbles.<br>Make sure amplifier is not too close to sources of interference. Electrical interference. |

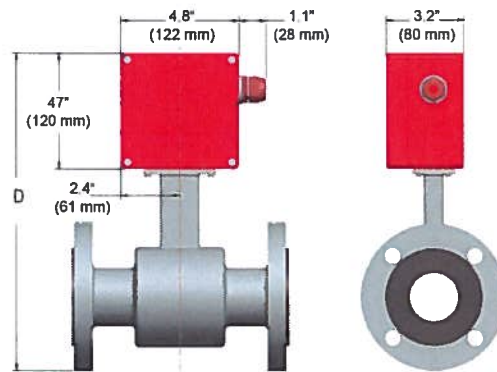
| Menu Manager Configuration Errors |   |   |
|-----------------------------------|---|---|
| Error                             | Description   | Recommended Action  |
| 110                               | <b>Output 1/2:</b> Pulse Output Configuration Error   | <p>This error is observed when improperly configuring the full scale flow, pulse per unit, or pulse width.</p> <p>This error can indicate the following configuration violations:</p> <ol style="list-style-type: none"> <li>1. Pulse frequency exceeds limits at full scale flow</li> <li>2. Pulse duty cycle is less than 50% at full scale flow (pulse on time &gt; pulse off time)</li> </ol> <p>Pulse frequency limit is 10 kHz. However, with a non-zero pulse width configuration, the limit is 500 Hz to achieve a 50% pulse duty cycle.</p> <p>If not using the pulse outputs, set the pulses per unit to zero to allow for reconfiguration of the full scale flow. If it is required to use the pulse outputs, reevaluate the pulse output configuration. Consider recording and clearing totalizers prior to changing totalizer units.</p> |
| 120                               | <b>Display:</b> Totalizer Conversion Error – Totalizer cannot be properly converted for display | This error is observed while trying to change the totalizer units. Limits of display will prevent improper configuration of the volume unit dependent on current totalizer values. Consider recording and cleaning totalizers prior to changing totalizer.  |
| 121                               | <b>Output 1/2:</b> Pulse Output Configuration Error   | This error is observed when changing the totalizer units of measure. This error implies the pulse configuration exceeds limits (see error 110). Please note the pulses per unit is not automatically updated on volume unit reconfiguration. The pulses per unit should be manually changed to accommodate the desired units of measure. It may be necessary to set the pulses per unit to zero then change to the desired totalizer units.   |
| 140                               | <b>Output 3:</b> Configuration Error – Full scale frequency exceeds limits of relay (1000 Hz)   | Reduce full scale frequency setting of output when hardware is configured for relay operation.  |
| 150                               | <b>Output 3:</b> Configuration Error – Full scale frequency exceeds limits (10 kHz)             | Reduce full scale frequency setting of output when hardware is configured for open collector operation.   |

| Display Error / Status Messages |  |   |
|---------------------------------|--|---|
| Error Message                   | Possible Cause                                 | Recommended Action  |
| Err: Detector                   | No detector connection with amplifier.         | Check detector and cable connections in accordance with this manual.  |
|                                 | Connection between amplifier and detector      | Contact Technical Support.  |
|                                 | Supply voltage too low.                        | Contact Technical Support.  |
|                                 | Grounded coils in meter.                       | Contact Technical Support.  |
|                                 | Water in detector.                             | Contact Technical Support.  |
| Err: Empty pipe                 | Pipe may not be full.                          | Make sure all trapped air is out of system.<br>If fluid or fluid conductivity recalibrate the parameter.              |
| Err: Full scale                 | Actual flow rate is exceeding programmed flow. | Reduce flow rate or increase the programmed full scale value by more than 5%.   |
| Err: AD-Range                   | AD-Converter is exceeding signal limits.       | Check the grounding scheme of the meter installation. See grounding section in this manual. Verify pipe is not empty. |
| Err: AD-INT                     | Initialization of AD-Converter unsuccessful.   | Contact Technical Support.  |
| Err: Rollover                   | Rollover counters have exceeded limit.         | Clear all totalizers.   |
| Err: Rollover Status            | Totalizer rollover has occurred.               | Reload totalizer then clear all totalizers.   |
| Err: Simulation                 | I/O simulator is enabled.                      | Disable simulator in I/O menu.  |

## Appendix: Detector Specifications



Meter with M-2000 amplifier



Meter with junction box for remote M-2000 amplifier

| Size  |      | A    |      | B    |      | C    |      | D    |      | Est. Weight with M-2000 |      | Flow Range |         |      |        |
|-------|------|------|------|------|------|------|------|------|------|-------------------------|------|------------|---------|------|--------|
| inch  | mm   | inch | mm   | inch | mm   | inch | mm   | inch | mm   | lbs                     | kg   | LPM        |         | GPM  |        |
|       |      |      |      |      |      |      |      |      |      |                         |      | min        | max     | min  | max    |
| 1/4   | 6    | 6.7  | 170  | 14.0 | 356  | 3.5  | 89   | 11.4 | 288  | 10                      | 4.5  | 0.063      | 20      | 0.02 | 5      |
| 5/16  | 8    | 6.7  | 170  | 14.0 | 356  | 3.5  | 89   | 11.4 | 288  | 10                      | 4.5  | 0.114      | 34      | 0.03 | 9      |
| 3/8   | 10   | 6.7  | 170  | 14.0 | 356  | 3.5  | 89   | 11.4 | 288  | 10                      | 4.5  | 0.177      | 53      | 0.05 | 14     |
| 1/2   | 15   | 6.7  | 170  | 14.0 | 356  | 3.5  | 89   | 11.4 | 288  | 10                      | 4.5  | 0.416      | 125     | 0.11 | 33     |
| 3/4   | 20   | 6.7  | 170  | 14.2 | 361  | 3.9  | 99   | 11.5 | 293  | 13                      | 5.5  | 0.75       | 225     | 0.2  | 59     |
| 1     | 25   | 8.9  | 225  | 14.4 | 366  | 4.3  | 108  | 11.7 | 298  | 18                      | 8.0  | 1.20       | 350     | 0.3  | 93     |
| 1 1/4 | 32   | 8.9  | 225  | 15.2 | 386  | 4.6  | 117  | 12.5 | 318  | 20                      | 9.0  | 2.00       | 575     | 0.5  | 152    |
| 1 1/2 | 40   | 8.9  | 225  | 15.4 | 390  | 5.0  | 127  | 12.7 | 322  | 21                      | 9.5  | 3.00       | 900     | 0.8  | 239    |
| 2     | 50   | 8.9  | 225  | 15.9 | 403  | 6.0  | 152  | 13.2 | 335  | 26                      | 11.5 | 4.70       | 1400    | 1    | 373    |
| 2 1/2 | 65   | 11.0 | 280  | 17.1 | 434  | 7.0  | 178  | 14.4 | 366  | 52                      | 23.5 | 8          | 2400    | 2    | 631    |
| 3     | 80   | 11.0 | 280  | 17.3 | 440  | 7.5  | 191  | 14.7 | 372  | 54                      | 24.5 | 12         | 3600    | 3    | 956    |
| 4     | 100  | 11.0 | 280  | 18.4 | 466  | 9.0  | 229  | 15.7 | 398  | 56                      | 25.5 | 19         | 5600    | 5    | 1493   |
| 5     | 125  | 15.8 | 400  | 19.6 | 498  | 10.0 | 254  | 16.9 | 430  | 58                      | 26.0 | 30         | 8800    | 8    | 2334   |
| 6     | 150  | 15.8 | 400  | 20.6 | 524  | 11.0 | 279  | 17.9 | 456  | 60                      | 27.0 | 40         | 12700   | 11   | 3361   |
| 8     | 200  | 15.8 | 400  | 22.5 | 572  | 13.5 | 343  | 20.4 | 518  | 86                      | 39.0 | 75         | 22600   | 20   | 5975   |
| 10    | 250  | 19.7 | 500  | 26.8 | 681  | 16.0 | 406  | 24.1 | 613  | 178                     | 81.0 | 120        | 35300   | 30   | 9336   |
| 12    | 300  | 19.7 | 500  | 28.9 | 734  | 19.0 | 483  | 26.2 | 666  | 207                     | 94.0 | 170        | 50800   | 45   | 13444  |
| 14    | 350  | 19.7 | 500  | 30.8 | 782  | 21.0 | 533  | 28.2 | 716  | 258                     | 117  | 230        | 69200   | 60   | 18299  |
| 16    | 400  | 23.6 | 590  | 33.7 | 856  | 23.5 | 597  | 31.0 | 788  | 306                     | 139  | 300        | 90400   | 80   | 23901  |
| 18    | 450  | 23.6 | 590  | 35.0 | 890  | 25.0 | 635  | 32.4 | 822  | 400                     | 181  | 380        | 114000  | 100  | 30250  |
| 20    | 500  | 23.6 | 590  | 38.2 | 969  | 27.5 | 699  | 35.5 | 901  | 493                     | 224  | 470        | 140000  | 125  | 37346  |
| 22    | 550  | 23.6 | 590  | 39.6 | 1005 | 29.5 | 749  | 36.9 | 937  | 523                     | 237  | 570        | 170000  | 150  | 45188  |
| 24    | 600  | 23.6 | 590  | 42.2 | 1071 | 32.0 | 813  | 39.5 | 1003 | 552                     | 251  | 680        | 200000  | 180  | 53778  |
| 28    | 700  | 23.6 | 590  | 46.2 | 1173 | 36.5 | 927  | 44.0 | 1118 | 648                     | 294  | 920        | 275000  | 240  | 73100  |
| 30    | 750  | 31.5 | 800  | 48.3 | 1228 | 39.0 | 984  | 45.7 | 1161 | 702                     | 319  | 1060       | 315000  | 280  | 84000  |
| 32    | 800  | 31.5 | 800  | 52.2 | 1325 | 41.4 | 1015 | 49.5 | 1257 | 768                     | 349  | 1200       | 361000  | 320  | 95600  |
| 36    | 900  | 31.5 | 800  | 55.3 | 1405 | 46.0 | 1168 | 54.1 | 1374 | 848                     | 385  | 1500       | 457000  | 400  | 121000 |
| 40    | 1000 | 31.5 | 800  | 60.0 | 1525 | 50.2 | 1230 | 57.4 | 1457 | 922                     | 419  | 1900       | 565000  | 500  | 149300 |
| 42    | 1050 | 36.0 | 914  | 66.0 | 1675 | 53.0 | 1346 | 63.4 | 1610 | 1198                    | 499  | 2100       | 620000  | 550  | 164600 |
| 48    | 1200 | 39.4 | 1000 | 69.9 | 1775 | 59.4 | 1455 | 67.2 | 1707 | 1208                    | 549  | 2700       | 814000  | 720  | 215100 |
| 54    | 1400 | 39.4 | 1000 | 78.5 | 1995 | 68.4 | 1675 | 75.9 | 1927 | 1362                    | 619  | 3700       | 1100000 | 980  | 292700 |

**Flow Range:** 0.1 - 39.4 fps (0.03-12 m/s)

**Sizes:** 1/4 inch to 54 inches (6 mm to 1400 mm)

**Min. Conductivity:** ≥ 5 micromhos/cm

**Accuracy:**

± 0.25 percent of rate for velocities greater than

1.64 ft/s (0.50 m/s)

± 0.004 ft/s (± 0.001 m/s) for velocities less than

1.64 ft/s (0.50 m/s)

**Electrode Materials:** Standard: Alloy C

Optional: 316 stainless steel, gold/platinum plated, tantalum, platinum/rhodium

**Liner Material:** PFA up to 3/8 inch, PTFE 1/2 inch to 24 inches, Soft and Hard Rubber from 1 to 54 inches, Halar<sup>®</sup> from 14 to 40 inches

**NSF Listed:** Models with hard rubber liner 4-inch size and up; PTFE liner - All sizes.

**Fluid Temperature:**

With Remote Amplifier:

PFA, PTFE & Halar 311°F (155°C)

Rubber 178°F, (80°C)

With Meter Mounted Amplifier:

PFA, PTFE & Halar 212°F (100°C)

Rubber 178°F, (80°C)

**Pressure Limits:**

Maximum allowable non-shock pressure and temperature ratings for steel pipe flanges, according to American National Standard ANSI B16.5. (Example: 150-pound flanges, rated 285 PSI at ambient temperature.) (Example: 300-pound flange rated 740 PSI at ambient temperature.)

**Coil Power:** Pulsed DC

**Ambient Temperature:** -4°F to 140°F (-20°C to 60°C)

**Pipe Spool Material:** 316 stainless steel

**Meter Housing Material:** Carbon steel welded

**Flanges:** Carbon steel - Standard (ANSI B16.5 Class 150 RF)

316 stainless steel - Optional

**Meter Enclosure Classification:** NEMA 4X (IP66)

**Optional:** Submersible NEMA 6P (remote amplifier required)

**Junction Box Enclosure Protection:**

(for remote amplifier option) Powder coated die-cast aluminum, NEMA 4 (IP65)

**Cable Entries:** 1/2-Inch NPT Cord Grip

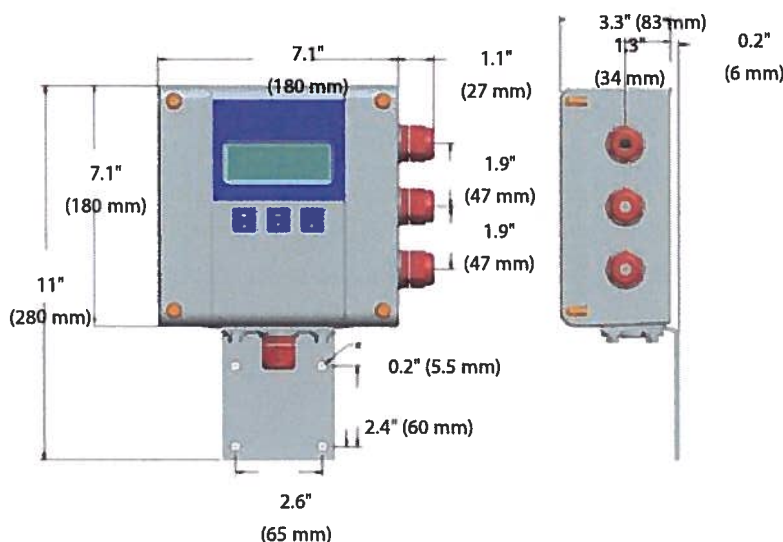
**Optional Stainless Steel Grounding Rings:**

**Meter Size** **Thickness (of one ring)**

up through 10 inches .135 inch

12 to 20 inches .187 inch

## Appendix: Amplifier Specifications



### Power Supply:

#### AC supply (85-265 VAC)

Typical power: 20 VA or 15 Watts

Max. power: 26 VA or 20 Watts

#### Optional DC supply (10-36 VDC)

Typical power: 10 Watts

Max. power: 14 Watts

**Accuracy:**  $\pm 0.25$  percent of rate for velocities greater than 1.64 ft/s (0.50 m/s)  
 $\pm 0.004$  ft/s ( $\pm 0.001$  m/s) for velocities less than 1.64 ft/s (0.50 m/s)

**Repeatability:**  $\pm 0.1$  percent

**Flow Range:** 0.10 to 39.4 ft/s (0.03 to 12 m/s)

**Fluid Conductivity:** Minimum 5.0 micromhos/cm

**Flow Direction:** Unidirectional or bidirectional two separate totalizers (programmable)

**Totalization:** Programmable/resettable

Unidirectional: T1, T2

Bidirectional: T+ (Fwd), T- (Rev), Tn (Net)

**Minimum Fluid Conductivity:** 5.0 micromhos/cm

**Processing:** 32-bit DSP

**Analog Output:** 4-20 mA, 0-20 mA, 0-10 mA, 2-10 mA (programmable and scalable)

Voltage sourced 24 VDC – isolated

Maximum loop resistance < 800 ohms

**Digital Outputs:** Four total, configurable

24 VDC sourcing active output (up to two), 100 mA total, 50 mA each; sinking open collector output (up to four), 30 VDC Max, 100 mA each; AC solid-state relay (up to two), 48 VAC, 500 mA max.

**Pulse Outputs:** Scalable up to 10 kHz, passive open collector up to 10 kHz, active switched 24 VDC. Up to two outputs (forward and reverse). Pulse width programmable from 1-1,000 ms or 50 percent duty cycle.

**Frequency Output:** Scalable up to 10 kHz, open collector up to 1 kHz, solid-state relay

**Misc Outputs:** High/low flow alarm (0-100 percent of flow), error alarm, empty pipe alarm, flow direction, preset batch alarm, 24 VDC supply

**Noise Dampening:** Programmable 0-30 seconds.

**Empty Pipe Detection:** Field tunable for optimum performance based on specific application

**Excitation Frequency:** 1 Hz, 3.75 Hz, 7.5 Hz or 15 Hz (factory optimized to pipe diameter)

**Digital Input:** Max. 30 VDC (programmable – positive zero return, external totalizer reset or preset batch start)

**Units of Measure:** Ounces, pounds, liters, US gallon, imperial gallon, barrel, hectoliter, megagallon, cubic meters, cubic feet, acre feet

**Galvanic Separation:** 250 volts

**Low-flow-cutoff:** Programmable 0-10 percent of max. flow

**LCD Display:** 4 x 20 character display with backlight

**Programming:** Three-button, external manual or remotely

**Housing:** Cast aluminum, powder-coated paint

**Housing Rating:** NEMA 4X (IP66)

**Mounting:** Meter mount or remote wall mount (bracket supplied)

**Cable Connection:** 1/2-inch NPT Cord Grip (three)

**Ambient Temperature:** -4 to 140° F (-20 to 60° C)

**Serial Communication:** RS232 – Modbus RTU or remote display

**Logging:** Power loss totalization

**Relative Humidity:** Up to 90 percent non-condensing

**Locations:** Indoor and outdoor



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**Badger Meter | P.O. Box 245036, Milwaukee, Wisconsin 53224-9536**  
**800-876-3837 | [infocentral@badgermeter.com](mailto:infocentral@badgermeter.com) | [www.badgermeter.com](http://www.badgermeter.com)**

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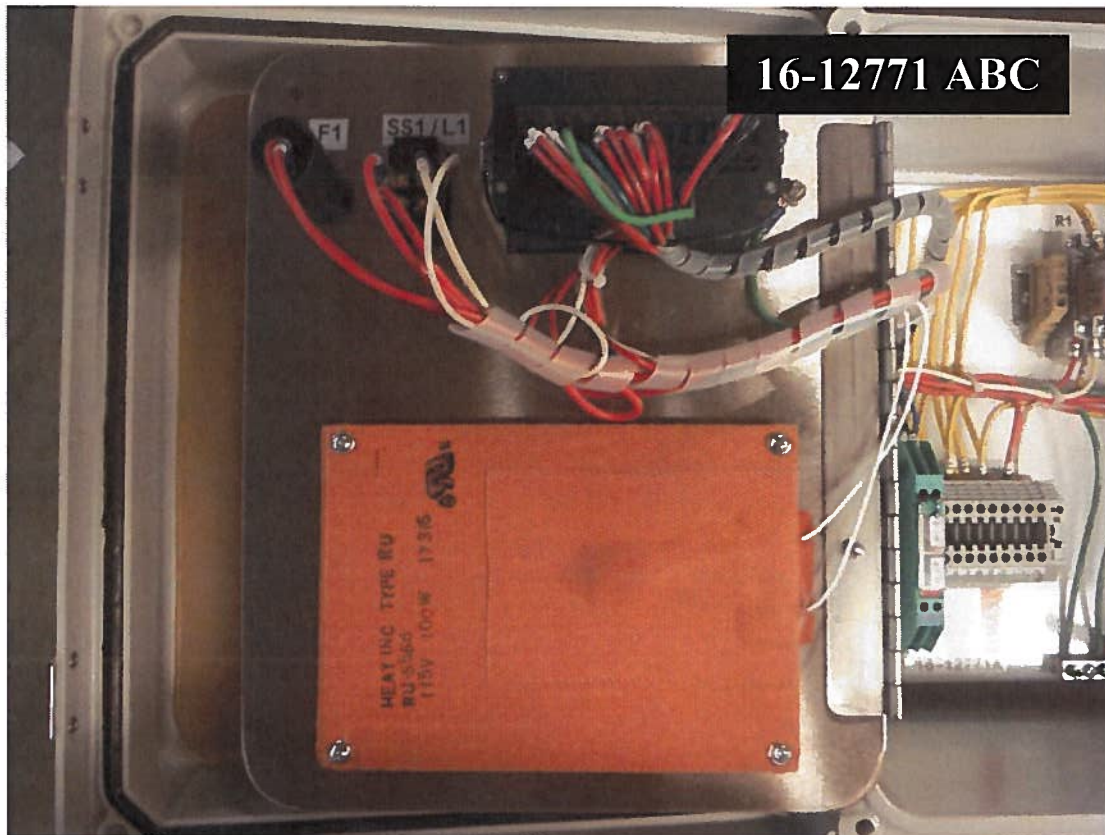
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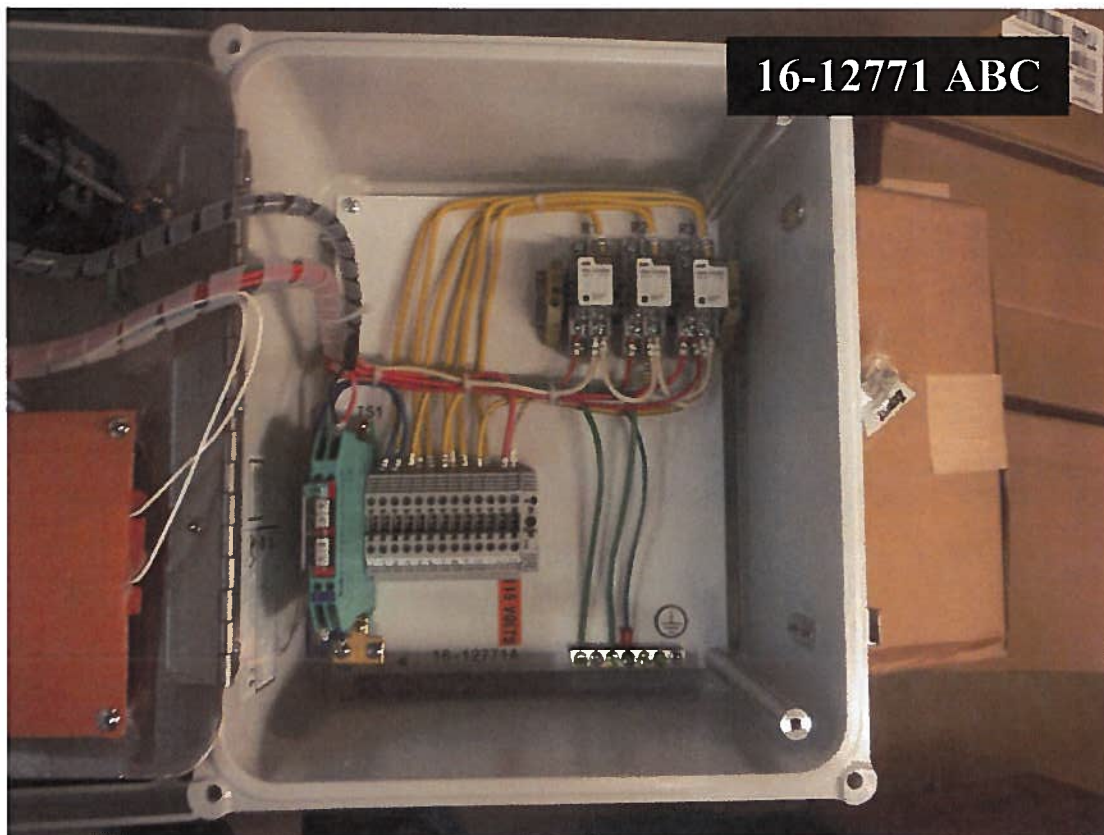
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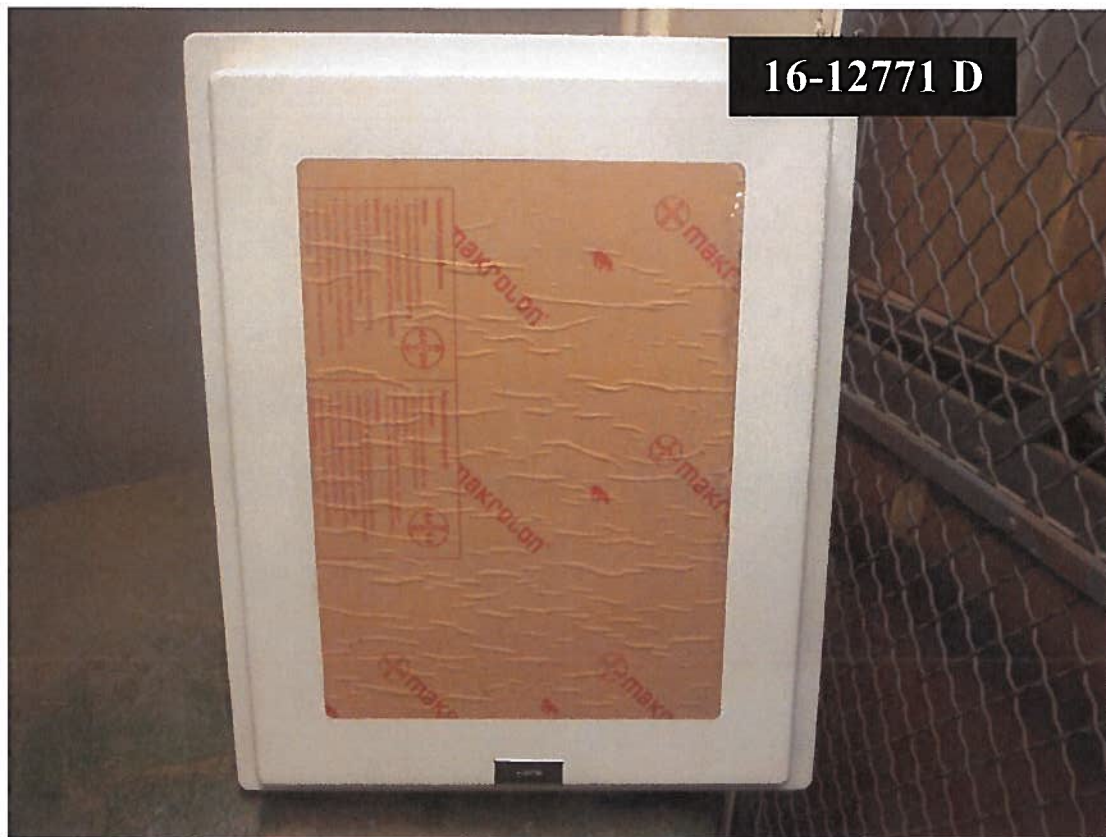
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# ***EPG Companies Inc.***

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***EPG Companies Inc.***

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## **LIMITED WARRANTY**

This agreement shall be deemed to have been entered into in the State of Minnesota, and shall be construed in accordance with the laws of the State of Minnesota, including Minnesota's enactment of the Uniform Commercial Code. Buyer hereby stipulates and agrees that Hennepin County, Minnesota shall be the proper jurisdiction for adjudicating all claims and controversies arising from this agreement.

Products manufactured by EPG Companies Inc. are warranted for a period of 12 months if Form 200 is returned (see Bulletin 0202), from date of installation or eighteen (18) months from date of manufacture\* to be free from defects of materials and workmanship. It is expressly agreed that the exclusive remedy under this warranty is limited solely to the repair or replacement, at the sole discretion of EPG, of the part that failed. The cost of labor for any field repairs is not covered by this warranty. EPG Companies will not be liable for any damage or wear due to abnormal conditions or improper installation.

Products not manufactured by EPG Companies Inc. are covered by the original manufacturer's warranty, which EPG Companies passes through to the purchaser. The actual manufacturer will make warranty determination.

To have a defective part repaired or replaced, you must return the defective product to EPG Companies. Please call (800) 443-7426 or (763) 424-2613 to obtain a RMA number. Send defective product (freight prepaid) with RMA #, description of installation, installation data and failure date to EPG Companies Inc., 19900 County Rd. 81, Maple Grove, MN 55311.

EPG Companies will not be held liable for any incidental or consequential damages, losses or expenses incurred from installation, use or any other reason. THERE ARE NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF EITHER FITNESS FOR A PARTICULAR PURPOSE OR OF MERCHANTABILITY, WHICH EXTEND BEYOND THOSE SPECIFICALLY LISTED HERE.

If equipment is to be stored for a period greater than six months, proper storage precautions must be taken if the warranty is to be maintained. Please call EPG Companies for specific requirements regarding product storage.

The following is a partial list of items, which will void the warranty:

- Opening the motor for any reason.
- Using undersized electrical wire.
- Making unauthorized circuit changes. Please call EPG Companies before making any changes.
- Operating a three phase submersible motor from single phase power through a phase converter unless 3-leg ambient-compensated quick trip overload protectors are used and complete details are sent in writing to EPG Companies.

\* To qualify for the delayed installation warranty you must contact EPG Companies Inc., at (800) 443-7426 or (763) 424-2613 within 60 days of purchase.

***EPG Companies Inc.***

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# **Operations & Maintenance Manual**

**FOR**

**GRP Mechanical  
Company, Inc.  
Solutia Judith Lane**

**EPG Job #16-12852**

# ***EPG Companies Inc.***

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## **Operations and Maintenance Index**

**GRP Mechanical Company, Inc. – Solutia Judith Lane**

**EPG Job # 16-12852**

|          |            |   |
|----------|------------|---|
| Bulletin | 1055       | List of Equipment   |
| Drawings | 11655-0250 | OCS Monitoring Panel Schematics   |
| Drawings | 11656-0250 | Pump Controller Schematics  |
| Bulletin | 8000b      | EPG Controllers With Intrinsically Safe Circuit(s) Field<br>Installation Instructions |
| Bulletin | 0580       | EPG LevelMaster™ Level Meter Model CH1000-SDHH<br>Operations & Set Up Instructions    |
| Bulletin | 0595       | CH1100 Operations & Configuration Manual  |
| Photo    | A          | Front Panel Layout  |
| Photo    | B          | Inner Door Layout   |
| Photo    | C          | Back of Inner Door Layout   |
| Photo    | D          | Back Panel Layout   |
| Bulletin | 0200d      | Limited Warranty  |

# ***EPG Companies Inc.***

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## **List of Equipment**

**GRP Mechanical Company, Inc. – Solutia Judith Lane**

**EPG Job # 16-12852**

- 1 each    OCS Monitoring Panel  
OCS Remote Monitoring Panel. To monitor 3 remote pump stations. Includes: OCS-004-102 (To display 3-levels from 4-20 mA inputs, 3-flows with flow rate totalizing from 4-20 mA inputs, 3-elapsed run times, 3-cycle counts, 3-high levels, 3-no-flows, door alarm, and leak detect), 3ea. high level alarm lights, 3ea. pump fail (no flow) lights, 1ea. door alarm light, 1ea. leak detect alarm light, and 8ea. dry outputs for auto dialer (3-high levels, 3-no-flows, door alarm, and leak detect). Enclosure is rated NEMA 4X Fiberglass.
  
- 3 each    Pump Controller  
Pump Controller to run a 1/2 HP 230 VAC 1 phase motor. Includes: Main disconnect, control fuses, (H)/O/A switch, contactor, start winding, stop/start input, pump run dry output circuit, remote shutdown circuit with pass along and outer door mounted alarm light. Enclosure is rated Nema 4.
  
- 3 each    CH1100-120VAC  
EPG LevelMaster Level Control Meter, one analog current input (4-20mA), featuring a re-transmitted, powered 4-20mA output. Supply power is 120 V.

CAUTION- DISCONNECT POWER  
BEFORE SERVICING  
THIS PANEL

NOTE: THE MAIN OVERCURRENT  
PROTECTION TO BE  
PROVIDED BY OTHERS

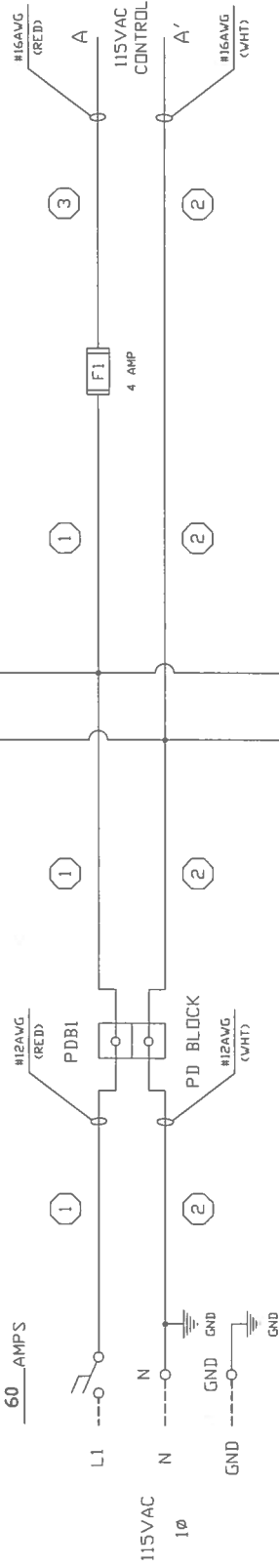
MAIN  
DISCONNECT  
60 AMPS

FIELD WIRING TERMINALS

LINE



115VAC 1PH 2 POLE 3 WIRE



SOLUTIA  
JUDITH LANE

(ADJUSTABLE)  
PANEL HEATER  
THERMOSTAT

MOUNTED BEHIND THE  
CONTROLS ENCLOSURE  
BACK PANEL

115VAC 10  
PANEL  
HEATER

FOR NOTES AND REVISIONS SEE SHEET 12

JOB NO. 16-12852A

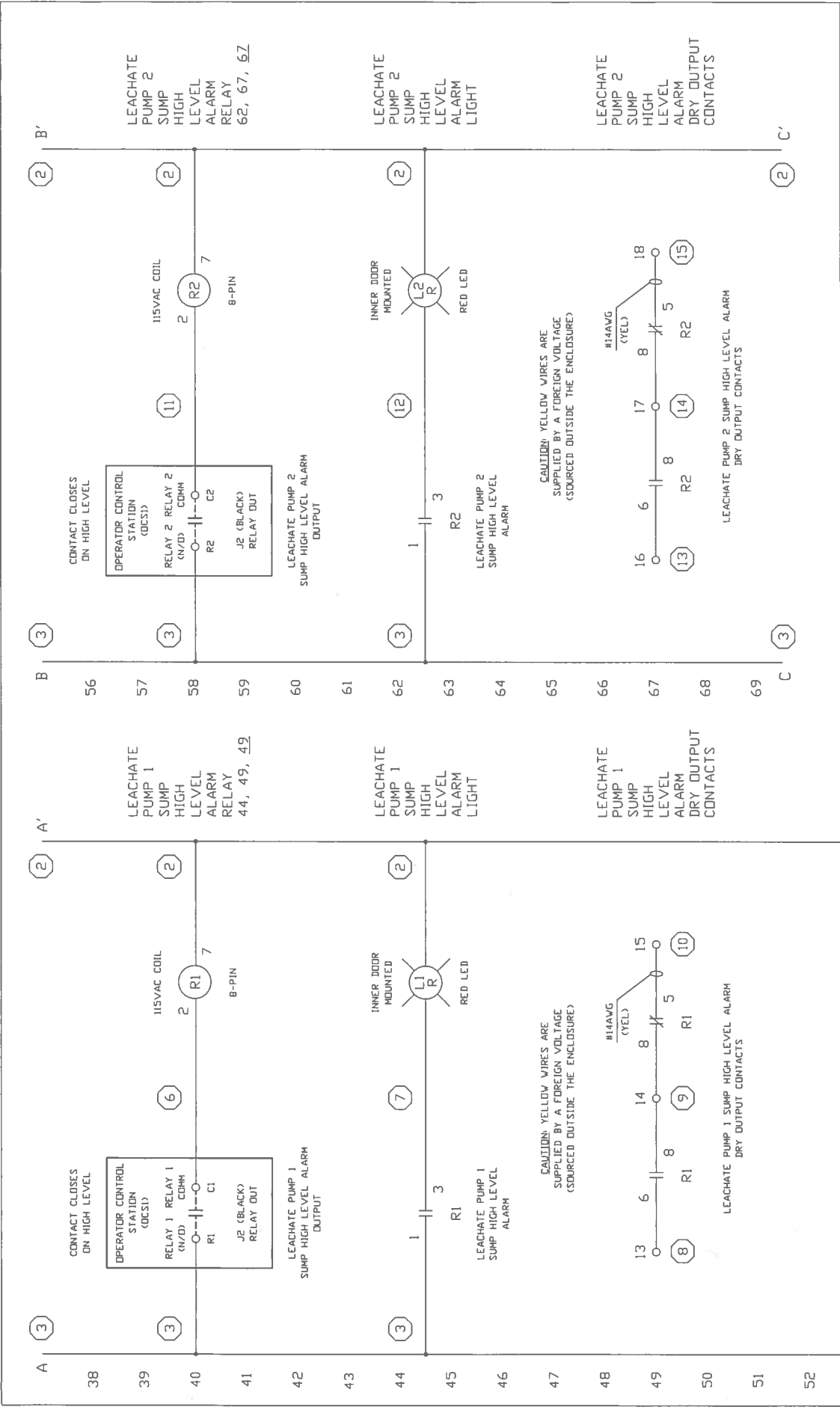
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| FUSE | TYPE  | VOLTS | AMPS  | RATING |
|------|-------|-------|-------|--------|
| F1   | FRN-R | 250   | 4     | 35     |
| F2   | FRN-R | 250   | 2-1/2 | 37     |

| TOLERANCES<br>EXCEPT AS NOTED | REVISIONS | DATE | BY |
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| 1                             | 1         |      |    |
| 2                             | 2         |      |    |
| 3                             | 3         |      |    |
| 4                             | 4         |      |    |
| 5                             | 5         |      |    |

|  |     |     |      |          |            |
|--|-----|-----|------|----------|------------|
| DCS MONITORING PANEL<br>115VAC 10 SH 1 OF 12 | RCK | RCK | DATE | 12-19-16 | 11655-0250 |
| INTERNAL                                     | RCK | RCK | DATE | 12-19-16 | 11655-0250 |
| INTERNAL                                     | RCK | RCK | DATE | 12-19-16 | 11655-0250 |



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DCS MONITORING PANEL

115VAC 1Ø SH 2 OF 12

RCK TACKLE

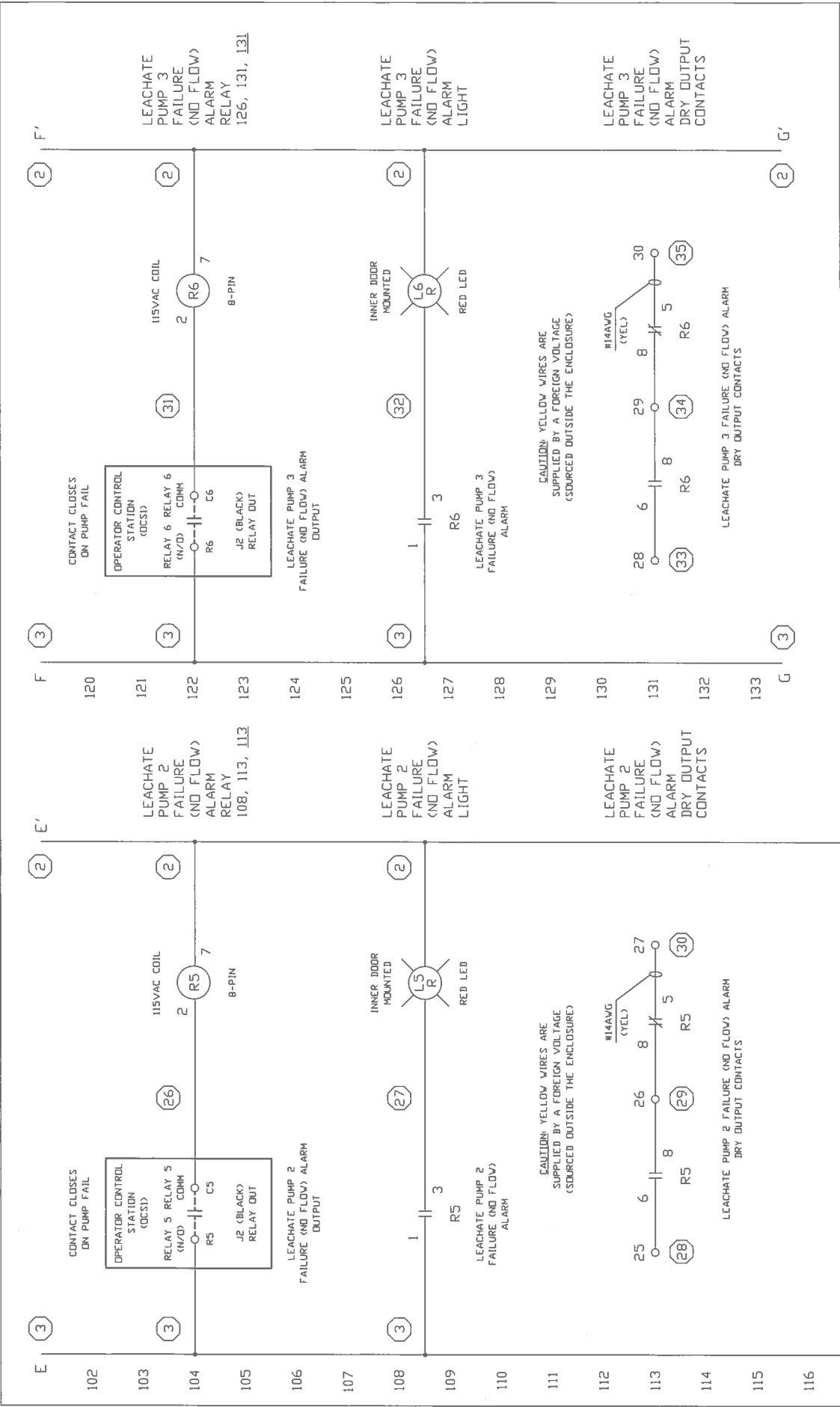
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DATE 12-19-16

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DCS MONITORING PANEL

115VAC 1Ø SH 4 OF 12

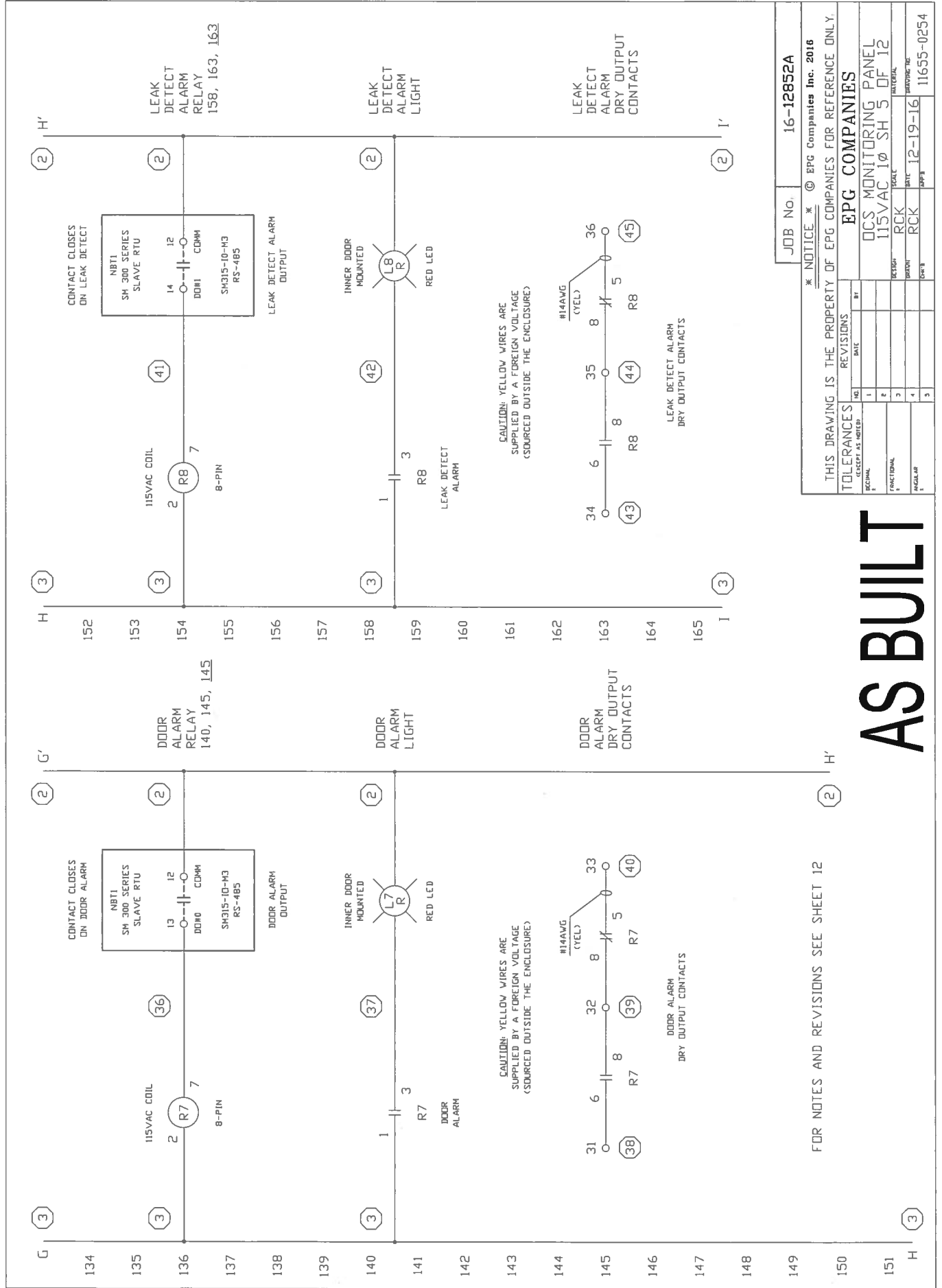
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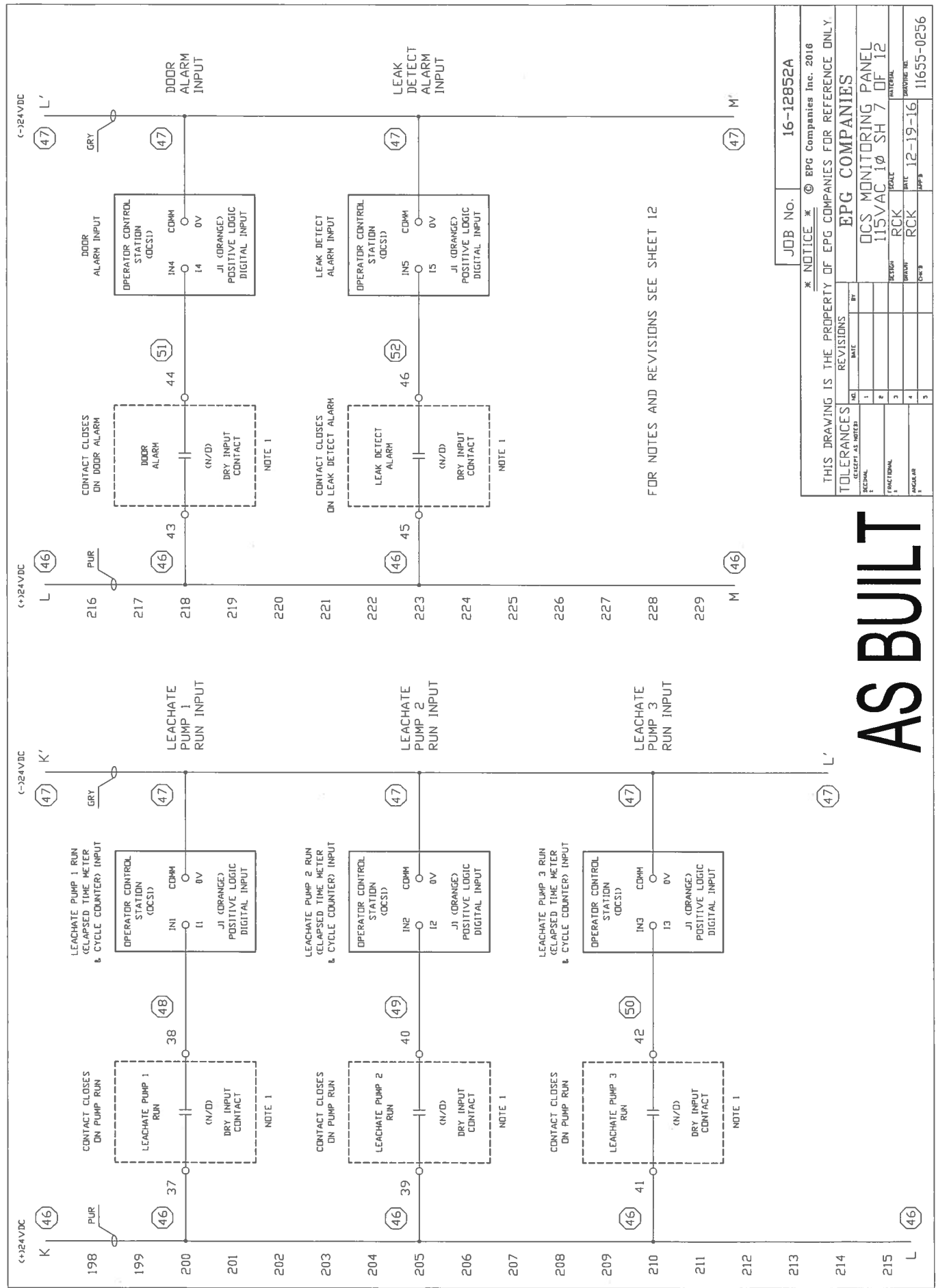
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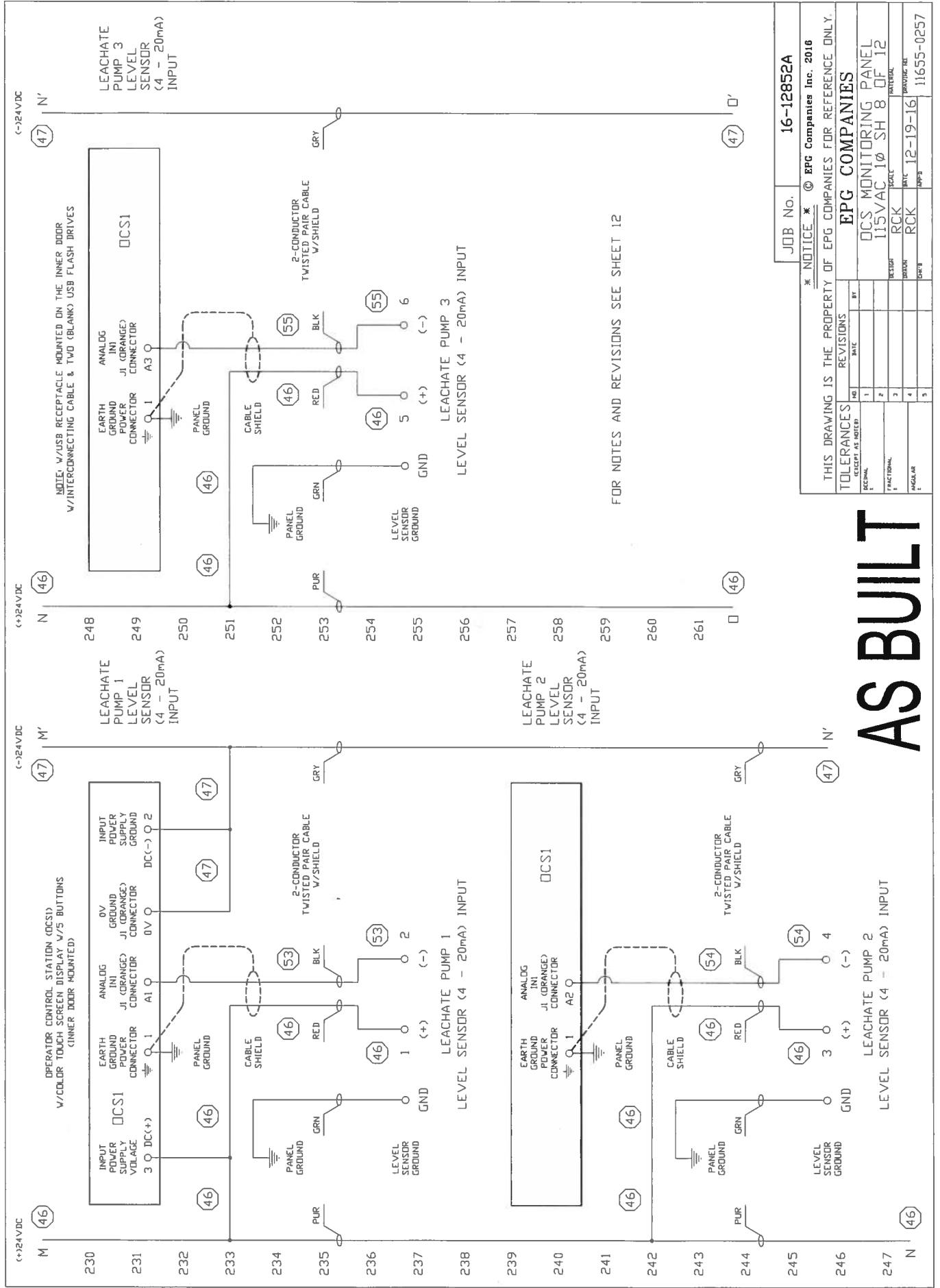
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